US010098176B2

(12) **United States Patent**
Iwai et al.

(10) **Patent No.: US 10,098,176 B2**
(45) **Date of Patent: *Oct. 9, 2018**

(54) **MOBILE COMMUNICATIONS SYSTEM, CONTROL APPARATUS, POLICY SUPPLY SYSTEM, STATE TRANSITION CONTROL METHOD, AND POLICY SUPPLY METHOD**

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(73) Assignee: **NEC CORPORATION**, Minato-ku, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 6 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/993,502**

(22) PCT Filed: **Nov. 21, 2011**

(86) PCT No.: **PCT/JP2011/006475**

§ 371 (c)(1),
(2), (4) Date: **Jun. 12, 2013**

(87) PCT Pub. No.: **WO2012/093434**

PCT Pub. Date: **Jul. 12, 2012**

(65) **Prior Publication Data**

US 2013/0273900 A1 Oct. 17, 2013

(30) **Foreign Application Priority Data**

Jan. 6, 2011 (JP) 2011-000992

(51) **Int. Cl.**
H04M 3/00 (2006.01)
H04W 76/28 (2018.01)
H04W 76/27 (2018.01)

(52) **U.S. Cl.**
CPC ***H04W 76/28*** (2018.02); ***H04W 76/27*** (2018.02)

(58) **Field of Classification Search**
CPC H04W 8/245
See application file for complete search history.

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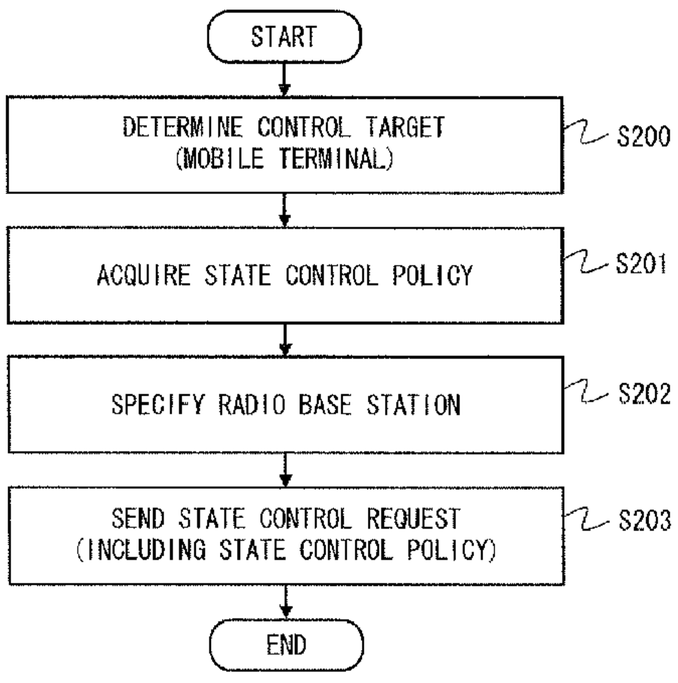
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A mobile communications system according to an aspect of the present invention includes a control apparatus (**100**) arranged in a radio access network (**20**) and a policy supply system (**200**) arranged in a core network (**10**). The policy supply system (**200**) is configured to supply the control apparatus (**100**) with a first control policy used in control related to state transition of a mobile terminal (**300**) between a CONNECTED state and an IDLE state. The control apparatus (**100**) is configured to perform the control related to the state transition between the CONNECTED state and the IDLE state for the mobile terminal (**300**) based on the first control policy. This enables, for example, to reduce the number of signalings which are caused due to repetition of state transition (CONNECTED-IDLE transition) of the

(Continued)



mobile terminal and are to be processed by the core network, based on the determination by the core network.

20 Claims, 23 Drawing Sheets

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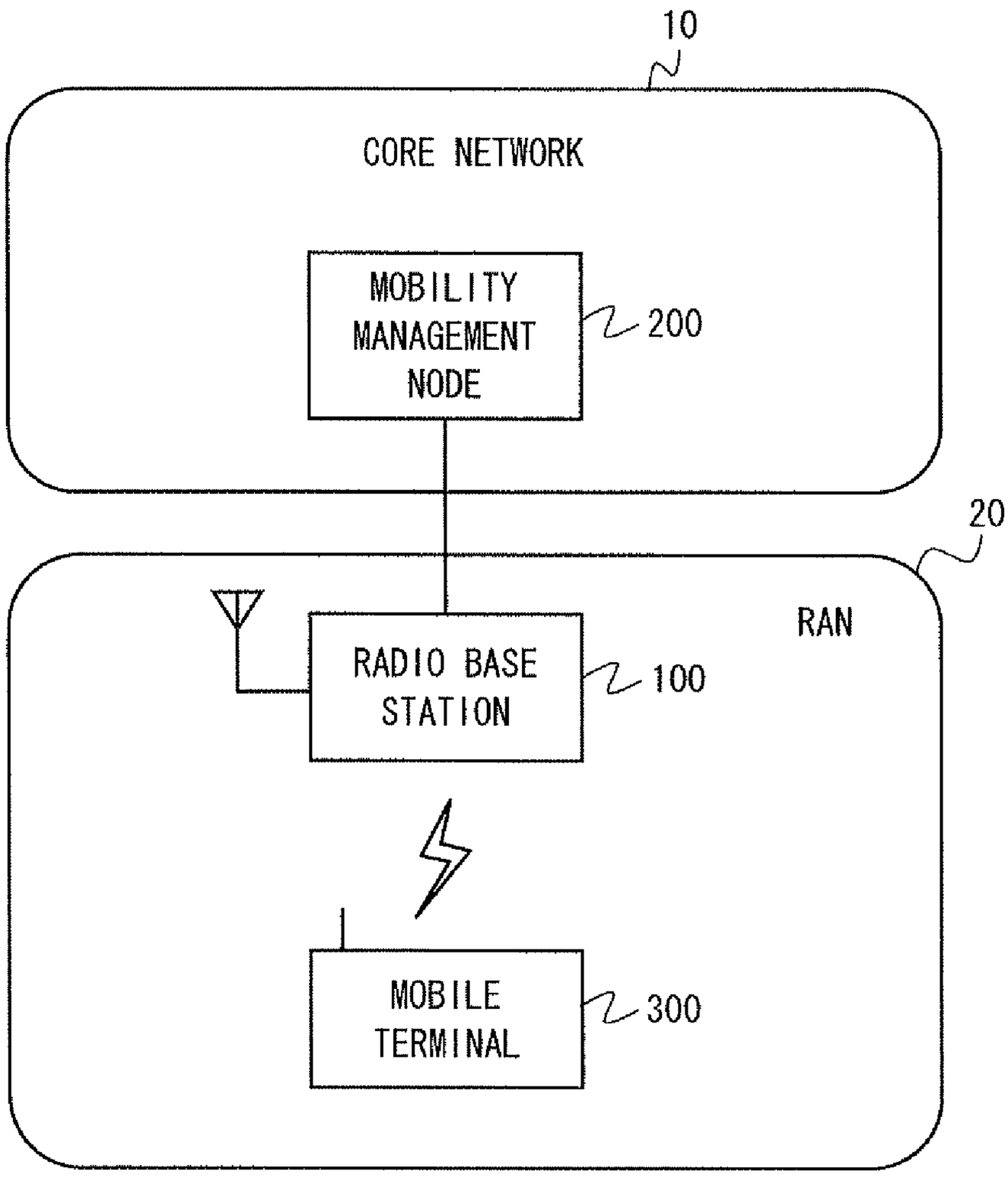
10
CORE NETWORK
MOBILITY MANAGEMENT NODE
200
20
RAN
RADIO BASE STATION
100
MOBILE TERMINAL
300

Fig. 1

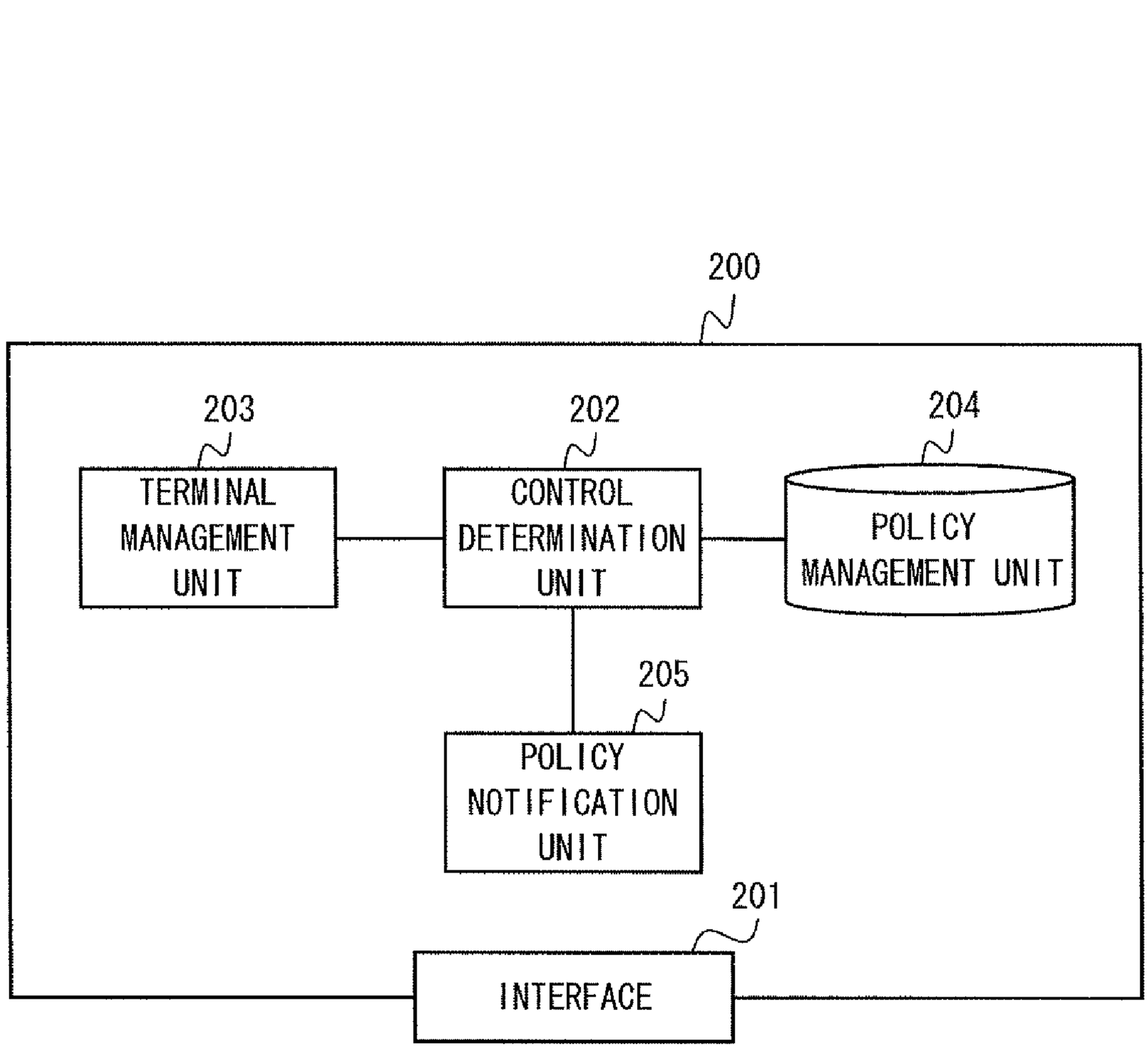
200
203
TERMINAL MANAGEMENT UNIT
202
CONTROL DETERMINATION UNIT
204
POLICY MANAGEMENT UNIT
205
POLICY NOTIFICATION UNIT
201
INTERFACE

Fig. 2

PRIMARY KEY	
ITEM	VALUE
CONTROL TARGET TERMINAL (TERMINAL ID)	0001
STATE CONTROL POLICY	
ITEM	VALUE
IDLE TRANSITION INTERVAL (sec)	120

Fig. 3

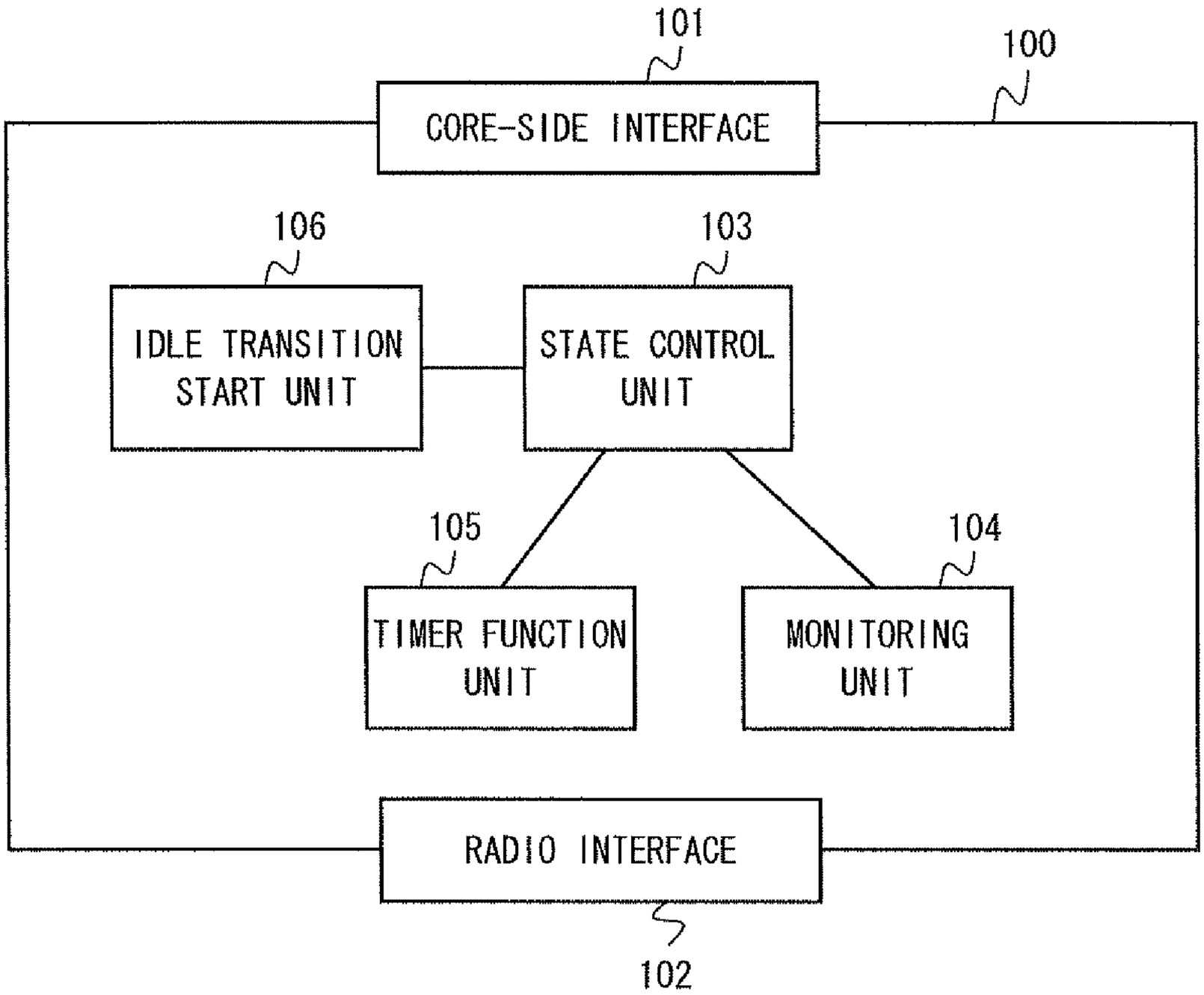

Fig. 4

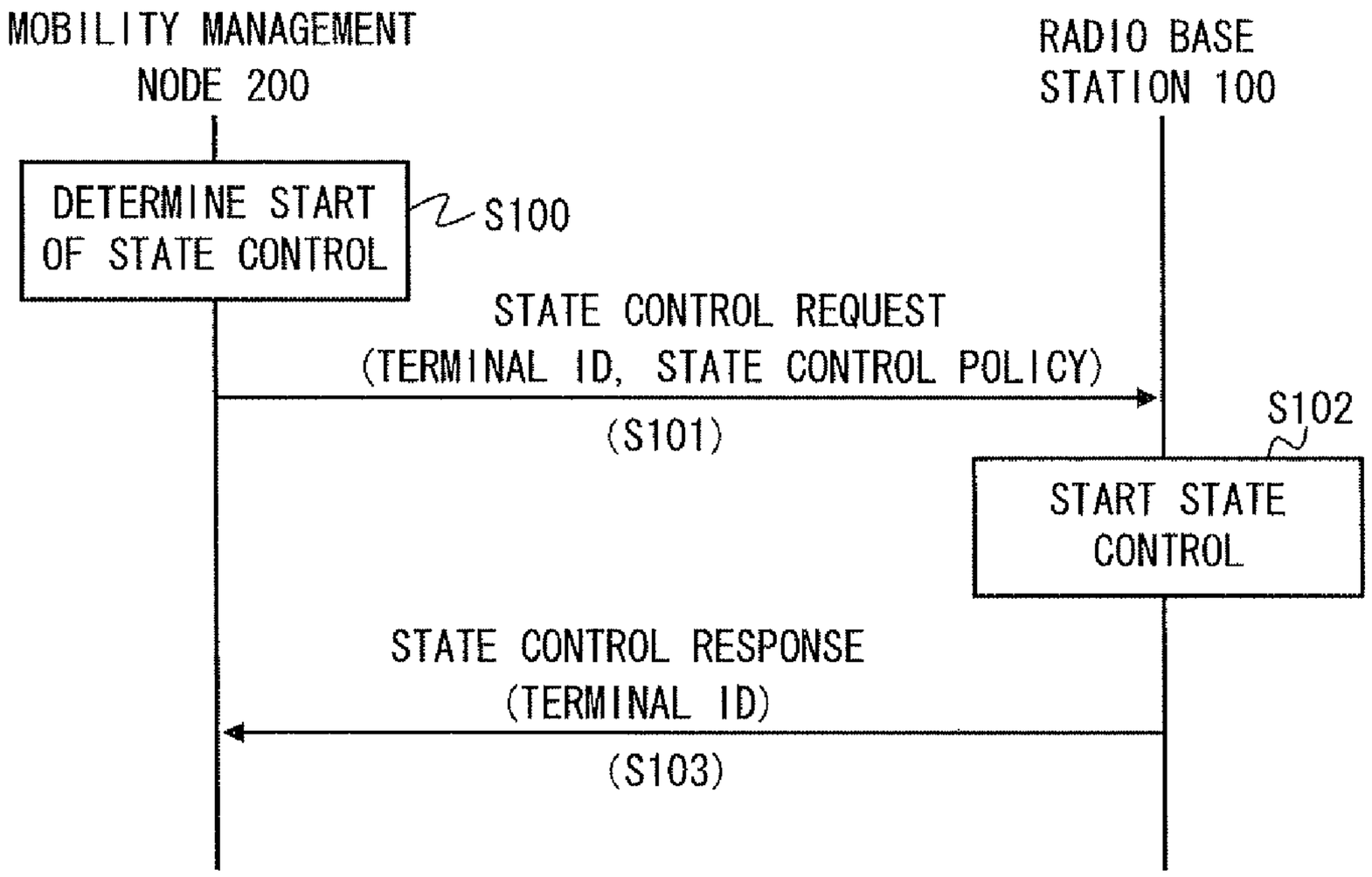
MOBILITY MANAGEMENT NODE 200
RADIO BASE STATION 100
DETERMINE START OF STATE CONTROL
S100
STATE CONTROL REQUEST
(TERMINAL ID, STATE CONTROL POLICY)
(S101)
S102
START STATE CONTROL
STATE CONTROL RESPONSE
(TERMINAL ID)
(S103)

Fig. 5

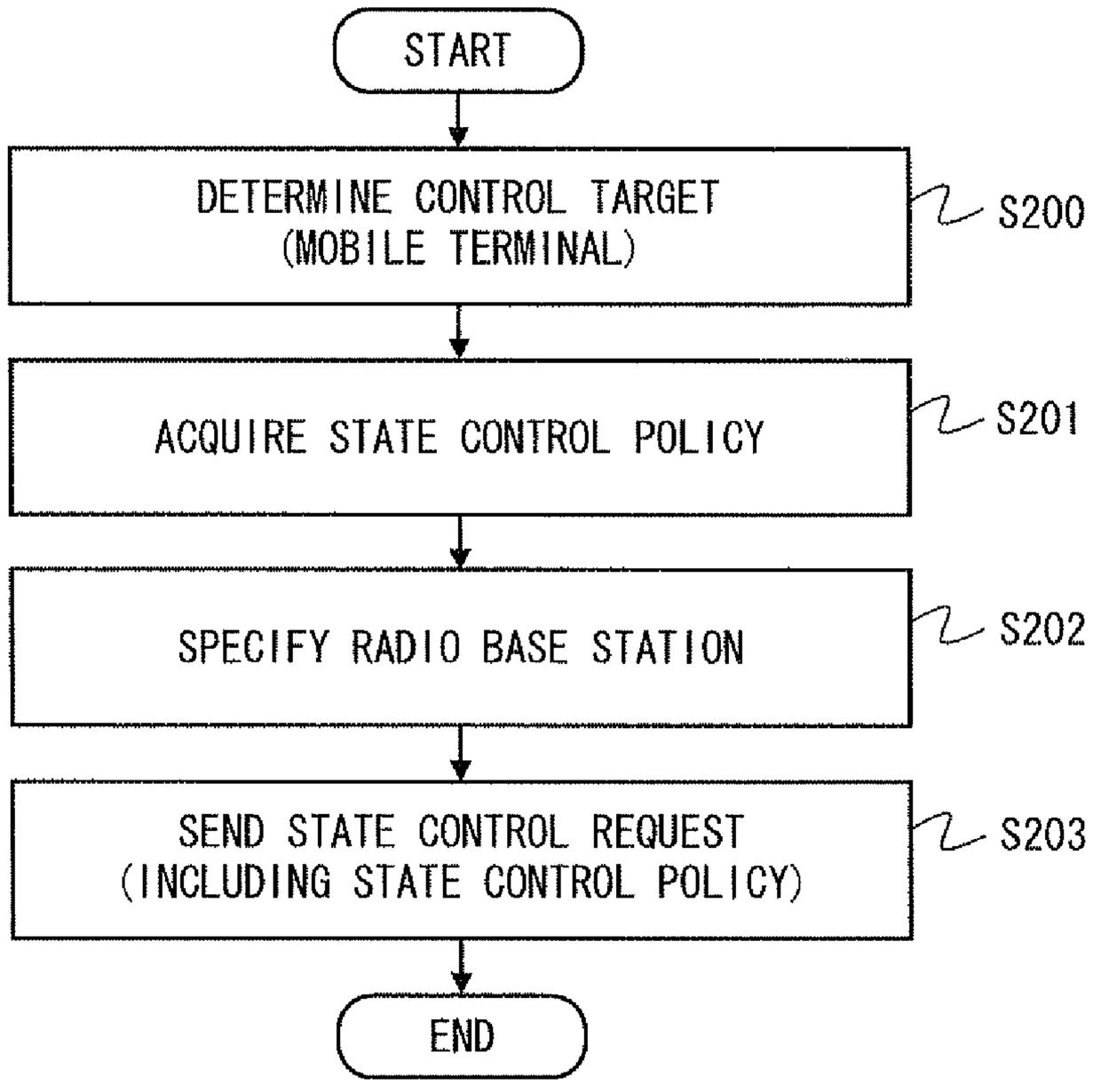
START
DETERMINE CONTROL TARGET (MOBILE TERMINAL)
S200
ACQUIRE STATE CONTROL POLICY
S201
SPECIFY RADIO BASE STATION
S202
SEND STATE CONTROL REQUEST (INCLUDING STATE CONTROL POLICY)
S203
END

Fig. 6

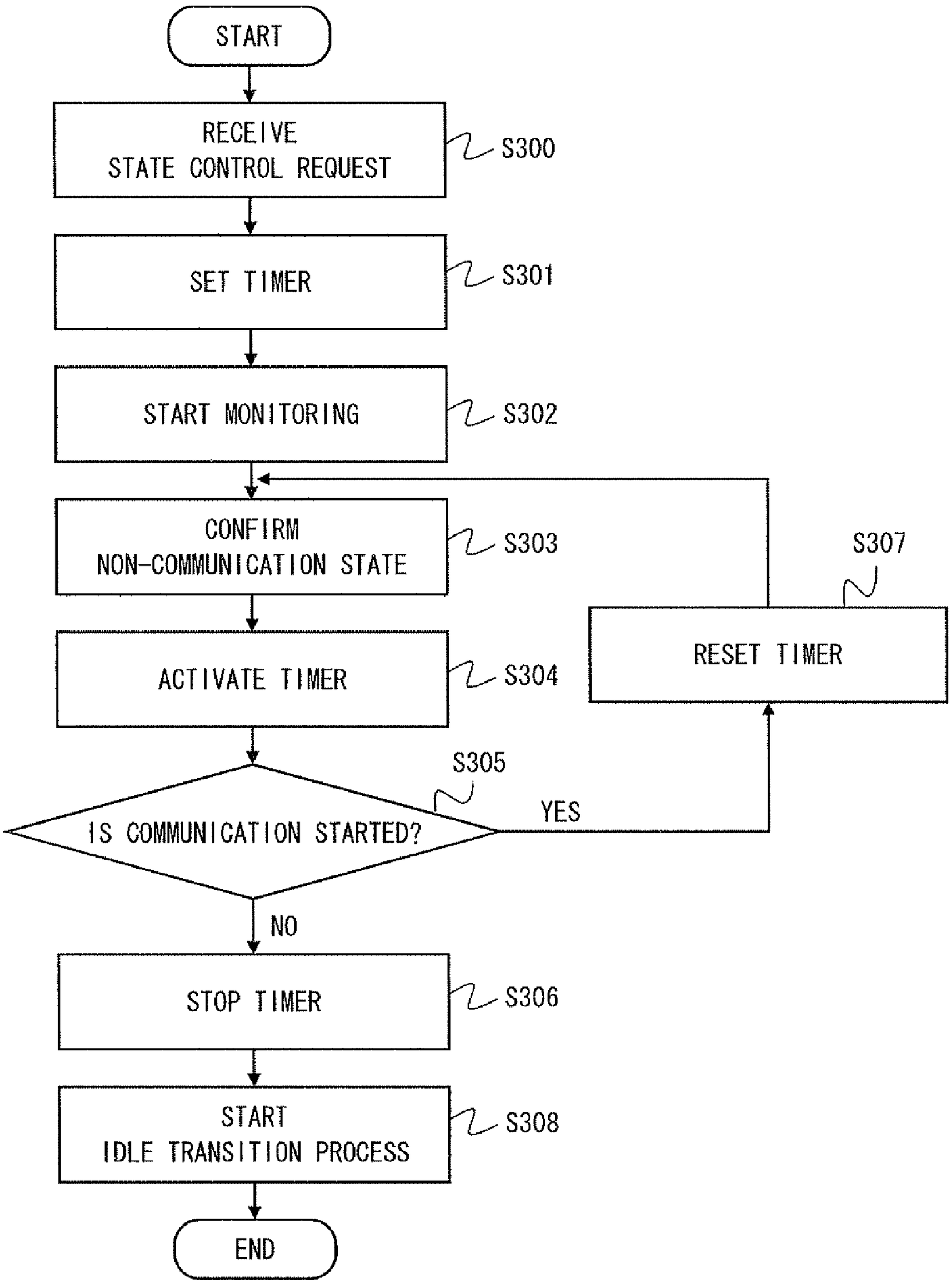
START
RECEIVE STATE CONTROL REQUEST
S300
SET TIMER
S301
START MONITORING
S302
CONFIRM NON-COMMUNICATION STATE
S303
ACTIVATE TIMER
S304
IS COMMUNICATION STARTED?
S305
YES
RESET TIMER
S307
NO
STOP TIMER
S306
START IDLE TRANSITION PROCESS
S308
END

Fig. 7

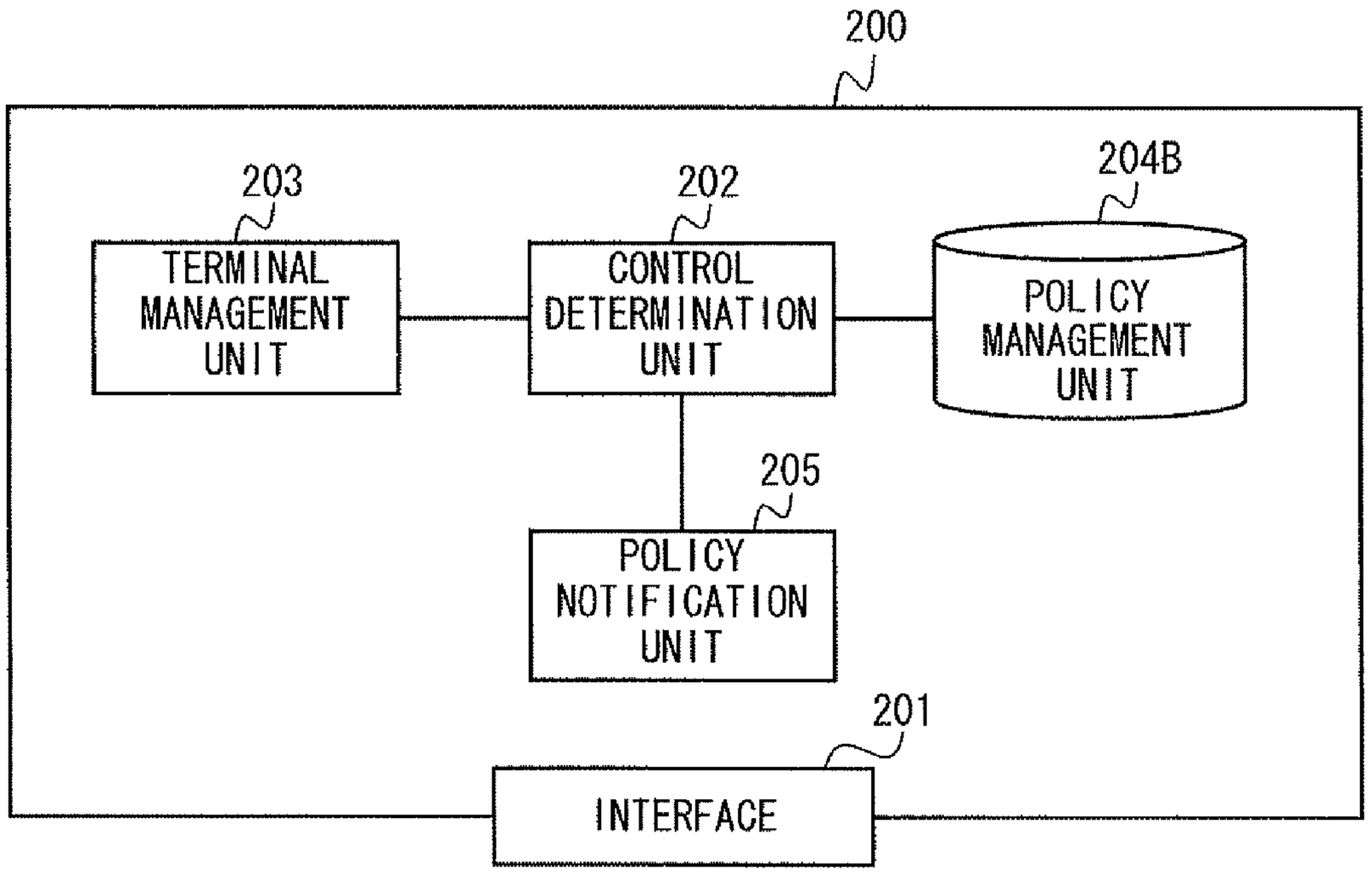
200
203
TERMINAL MANAGEMENT UNIT
202
CONTROL DETERMINATION UNIT
204B
POLICY MANAGEMENT UNIT
205
POLICY NOTIFICATION UNIT
201
INTERFACE

Fig. 8

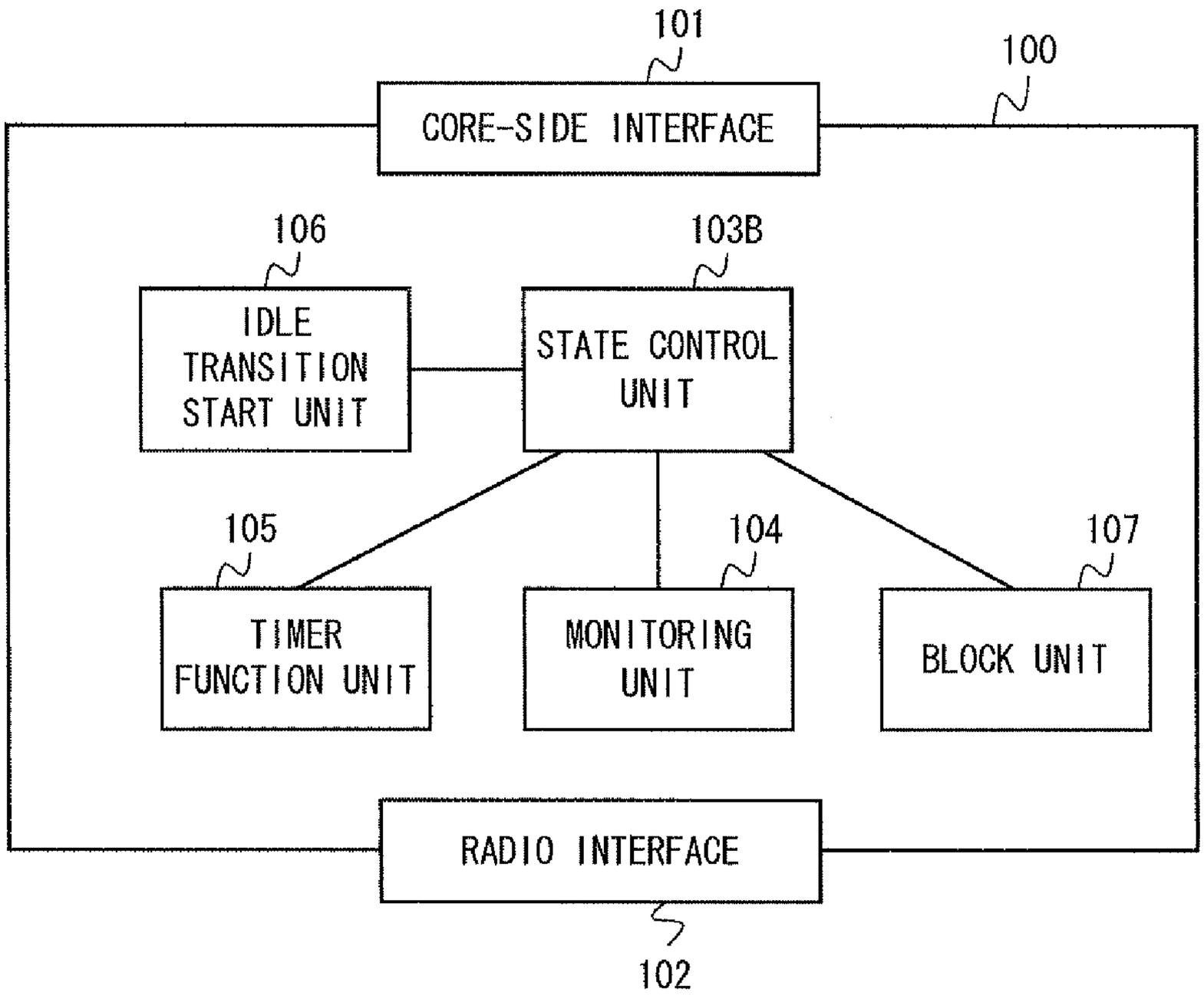
101
CORE-SIDE INTERFACE
100
106
IDLE TRANSITION START UNIT
103B
STATE CONTROL UNIT
105
TIMER FUNCTION UNIT
104
MONITORING UNIT
107
BLOCK UNIT
RADIO INTERFACE
102

Fig. 9

PRIMARY KEY	
ITEM	VALUE
CONTROL TARGET TERMINAL (TERMINAL ID)	0001
STATE CONTROL POLICY	
ITEM	VALUE
IDLE TRANSITION INTERVAL (sec)	120
BLOCK POLICY	TERMINAL REQUEST O&M SERVER REQUEST

Fig. 10

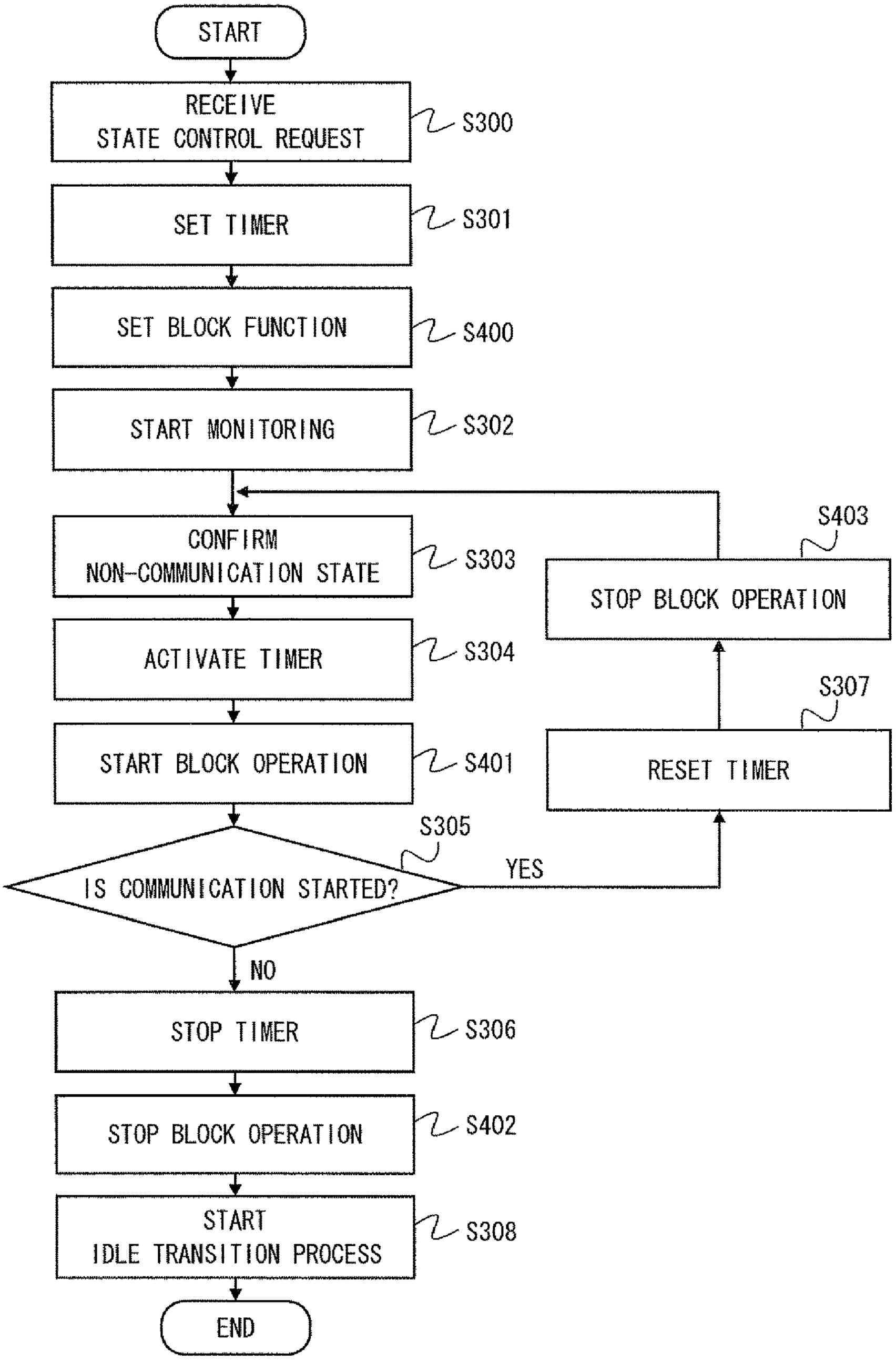
START
RECEIVE STATE CONTROL REQUEST
S300
SET TIMER
S301
SET BLOCK FUNCTION
S400
START MONITORING
S302
CONFIRM NON-COMMUNICATION STATE
S303
ACTIVATE TIMER
S304
START BLOCK OPERATION
S401
IS COMMUNICATION STARTED?
S305
YES
NO
STOP TIMER
S306
STOP BLOCK OPERATION
S402
START IDLE TRANSITION PROCESS
S308
END
STOP BLOCK OPERATION
S403
RESET TIMER
S307

Fig. 11

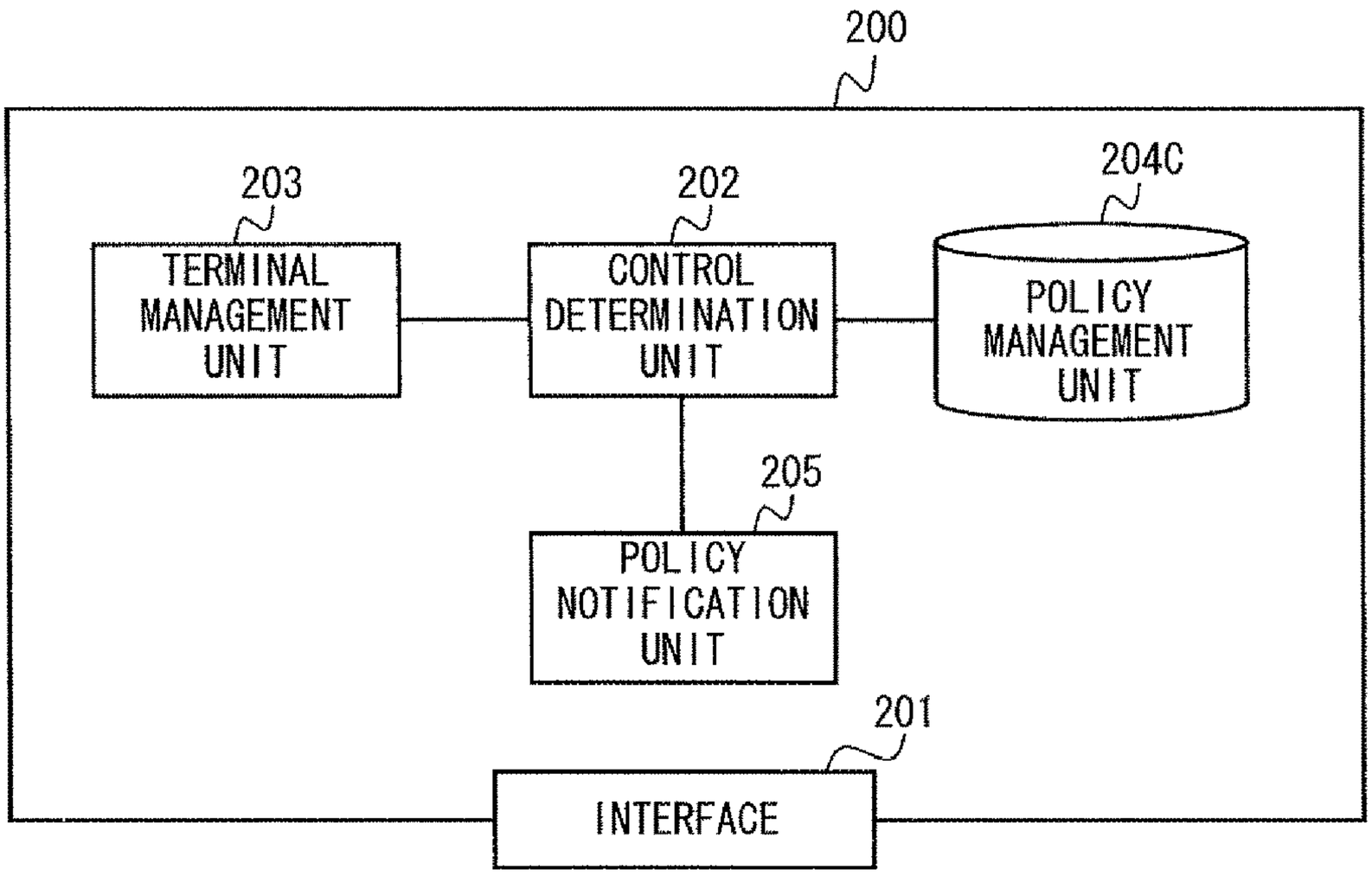
200
203
TERMINAL MANAGEMENT UNIT
202
CONTROL DETERMINATION UNIT
204C
POLICY MANAGEMENT UNIT
205
POLICY NOTIFICATION UNIT
201
INTERFACE

Fig. 12

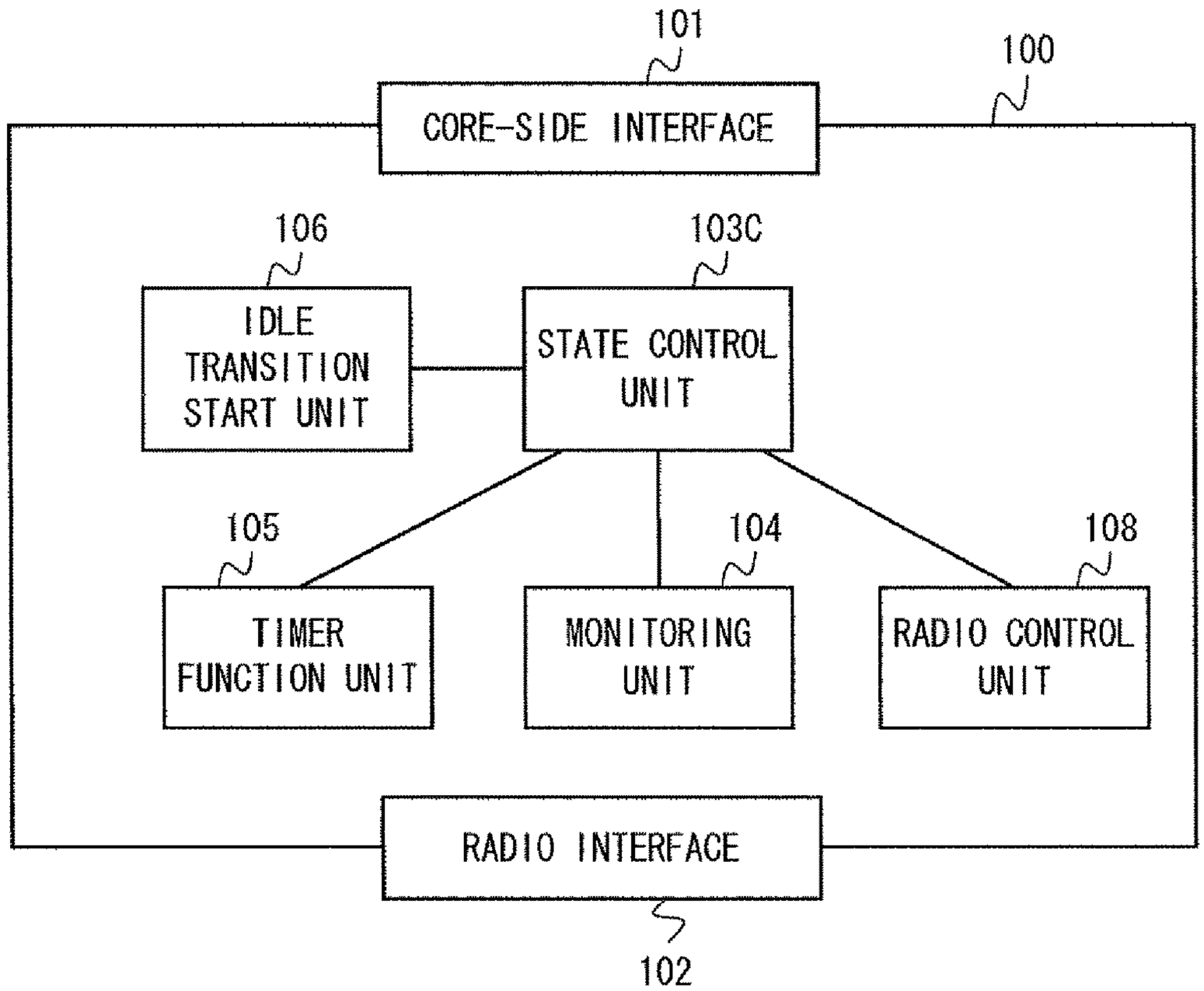
101
CORE-SIDE INTERFACE
100
106
IDLE TRANSITION START UNIT
103C
STATE CONTROL UNIT
105
TIMER FUNCTION UNIT
104
MONITORING UNIT
108
RADIO CONTROL UNIT
RADIO INTERFACE
102

Fig. 13

PRIMARY KEY	
ITEM	VALUE
CONTROL TARGET TERMINAL (TERMINAL ID)	0001
STATE CONTROL POLICY	
ITEM	VALUE
IDLE TRANSITION INTERVAL (sec)	120
RADIO CONTROL POLICY DRX VALUE (msec)	10

Fig. 14

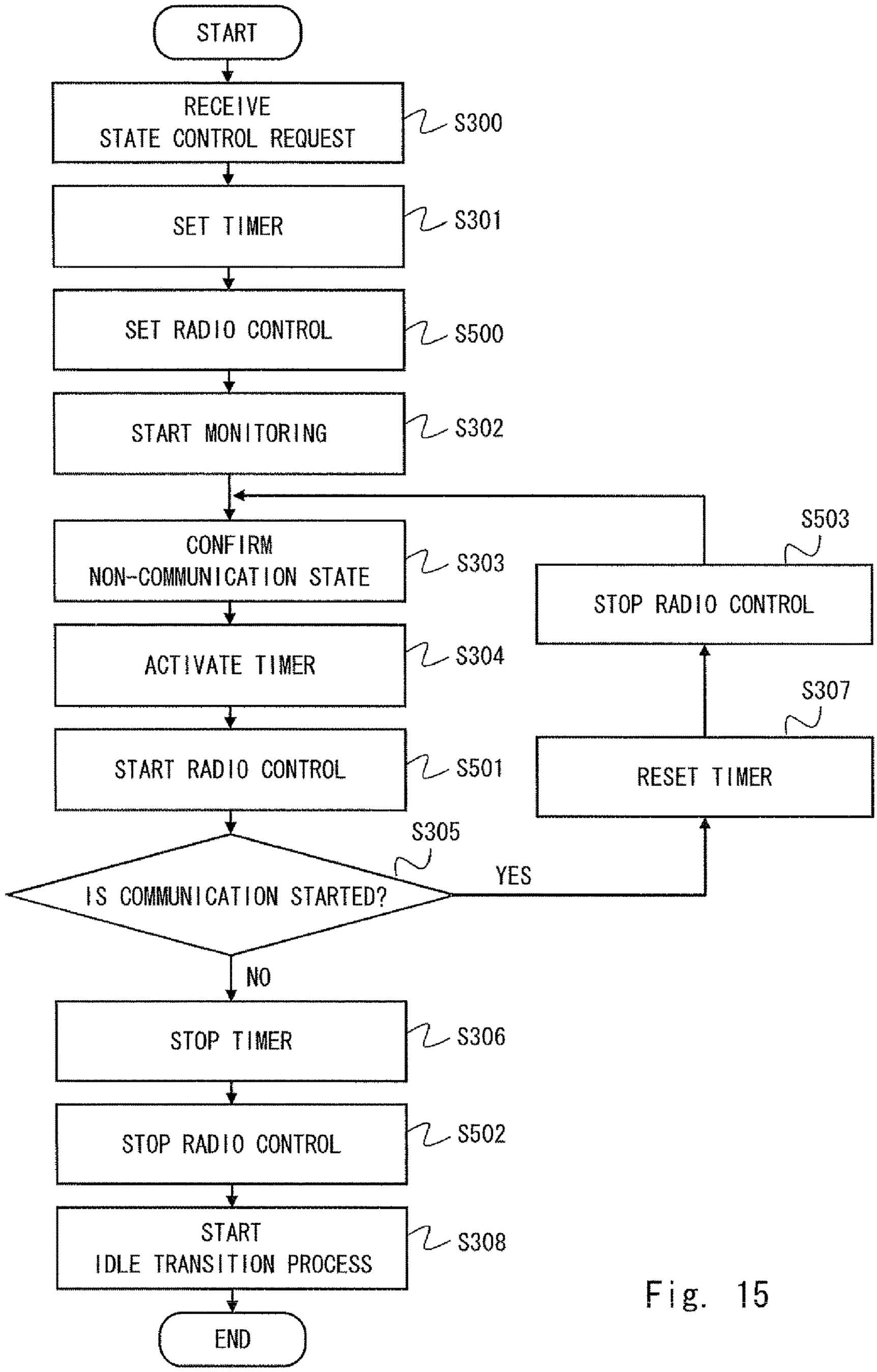
START
RECEIVE STATE CONTROL REQUEST
S300
SET TIMER
S301
SET RADIO CONTROL
S500
START MONITORING
S302
CONFIRM NON-COMMUNICATION STATE
S303
ACTIVATE TIMER
S304
START RADIO CONTROL
S501
IS COMMUNICATION STARTED?
S305
YES
NO
STOP TIMER
S306
STOP RADIO CONTROL
S502
START IDLE TRANSITION PROCESS
S308
END
STOP RADIO CONTROL
S503
RESET TIMER
S307

Fig. 15

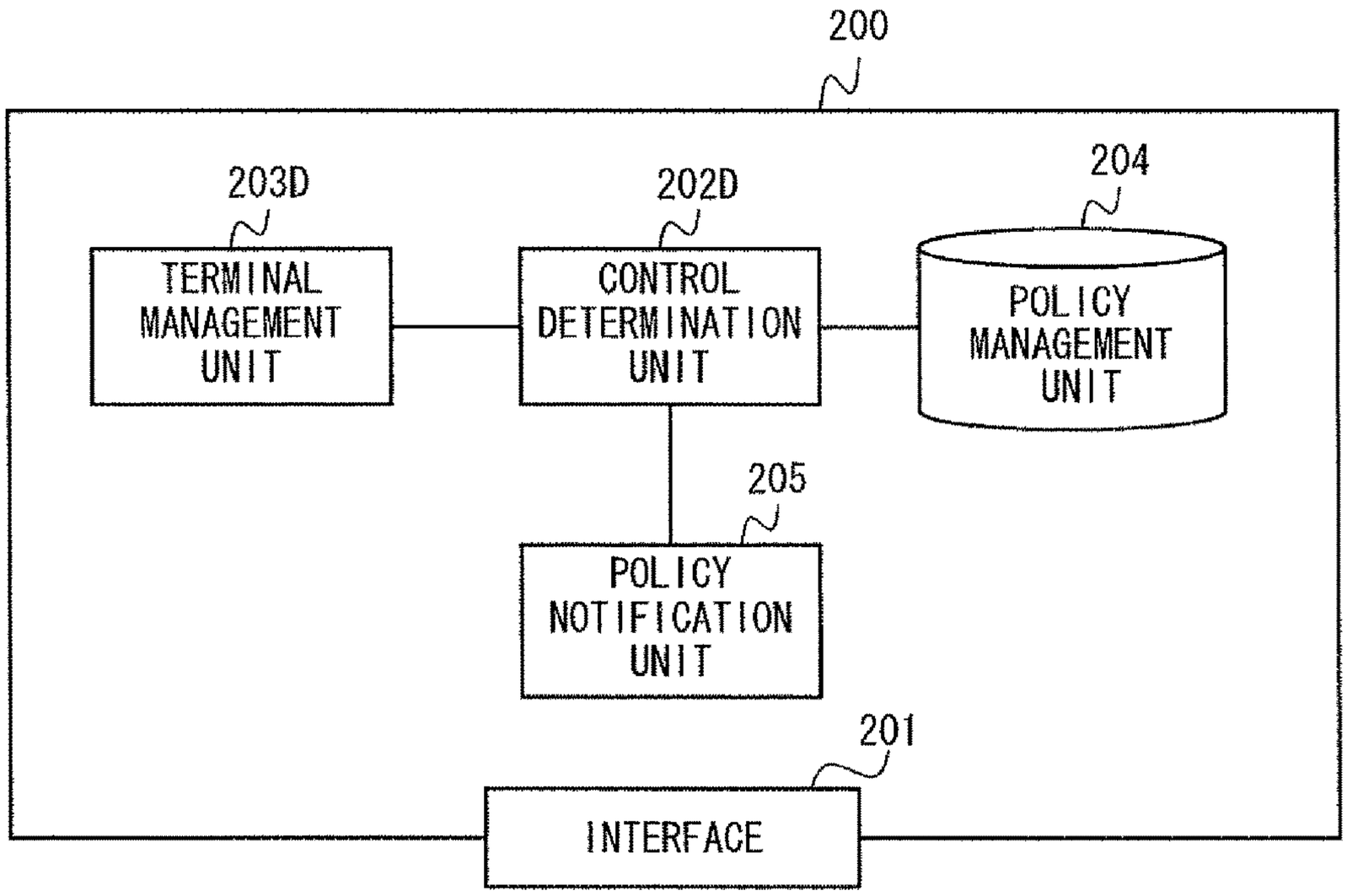
200
203D
TERMINAL MANAGEMENT UNIT
202D
CONTROL DETERMINATION UNIT
204
POLICY MANAGEMENT UNIT
205
POLICY NOTIFICATION UNIT
201
INTERFACE

Fig. 16

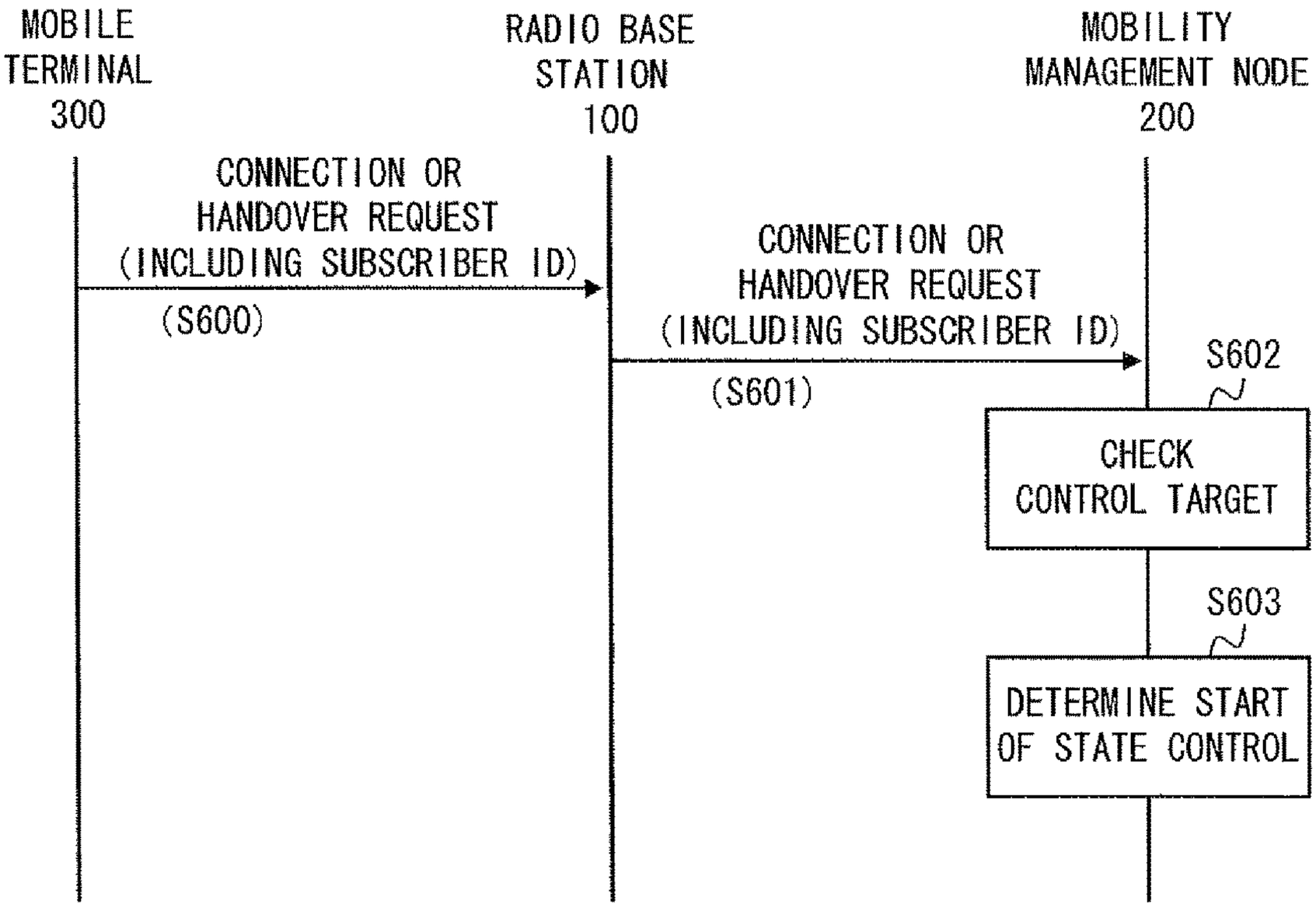
MOBILE TERMINAL 300
RADIO BASE STATION 100
MOBILITY MANAGEMENT NODE 200
CONNECTION OR HANDOVER REQUEST (INCLUDING SUBSCRIBER ID)
(S600)
CONNECTION OR HANDOVER REQUEST (INCLUDING SUBSCRIBER ID)
(S601)
S602
CHECK CONTROL TARGET
S603
DETERMINE START OF STATE CONTROL

Fig. 17

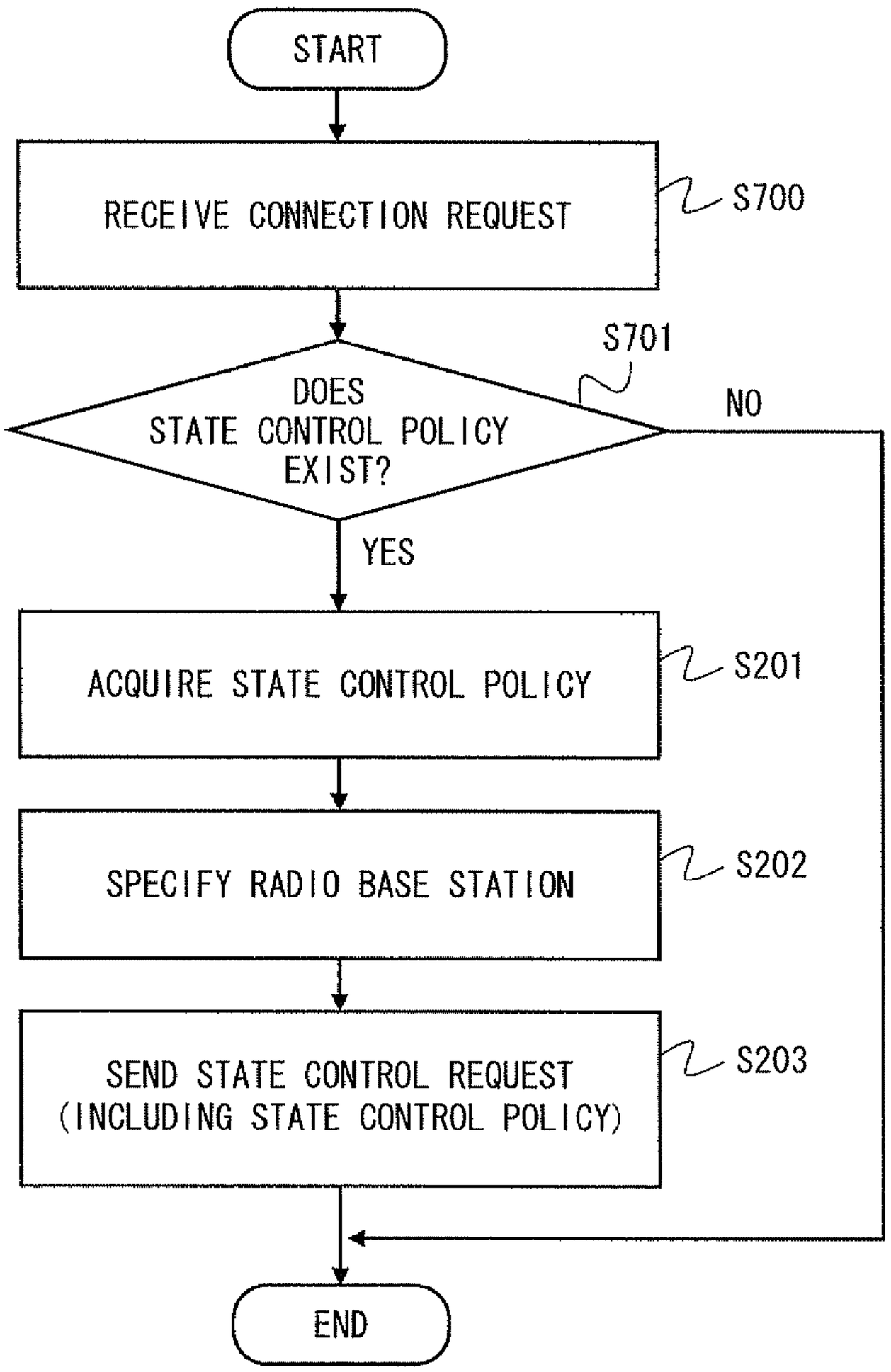
START
RECEIVE CONNECTION REQUEST
S700
S701
DOES STATE CONTROL POLICY EXIST?
NO
YES
ACQUIRE STATE CONTROL POLICY
S201
SPECIFY RADIO BASE STATION
S202
SEND STATE CONTROL REQUEST (INCLUDING STATE CONTROL POLICY)
S203
END

Fig. 18

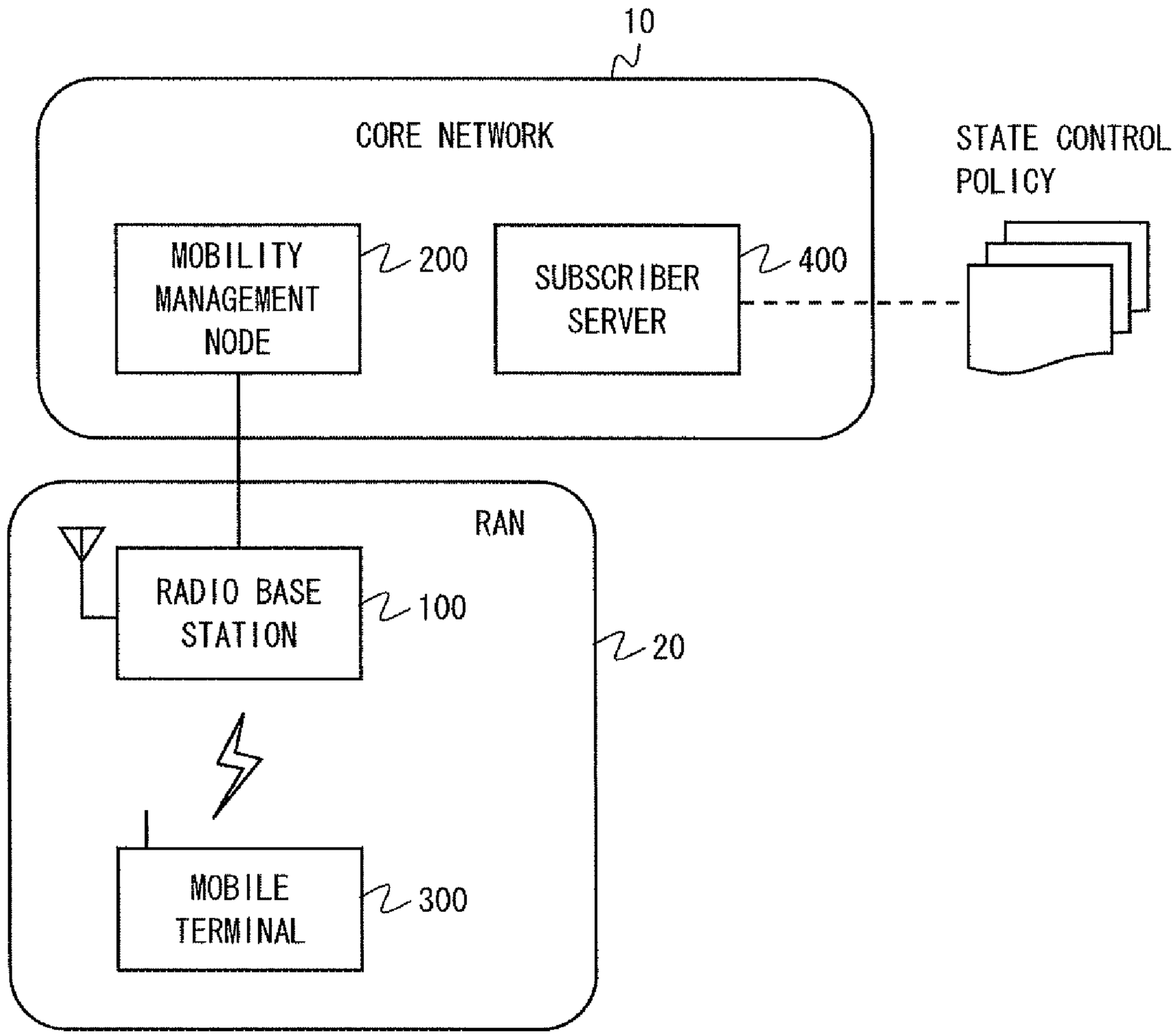
10
CORE NETWORK
STATE CONTROL POLICY
MOBILITY MANAGEMENT NODE
200
SUBSCRIBER SERVER
400
RAN
RADIO BASE STATION
100
20
MOBILE TERMINAL
300

Fig. 19

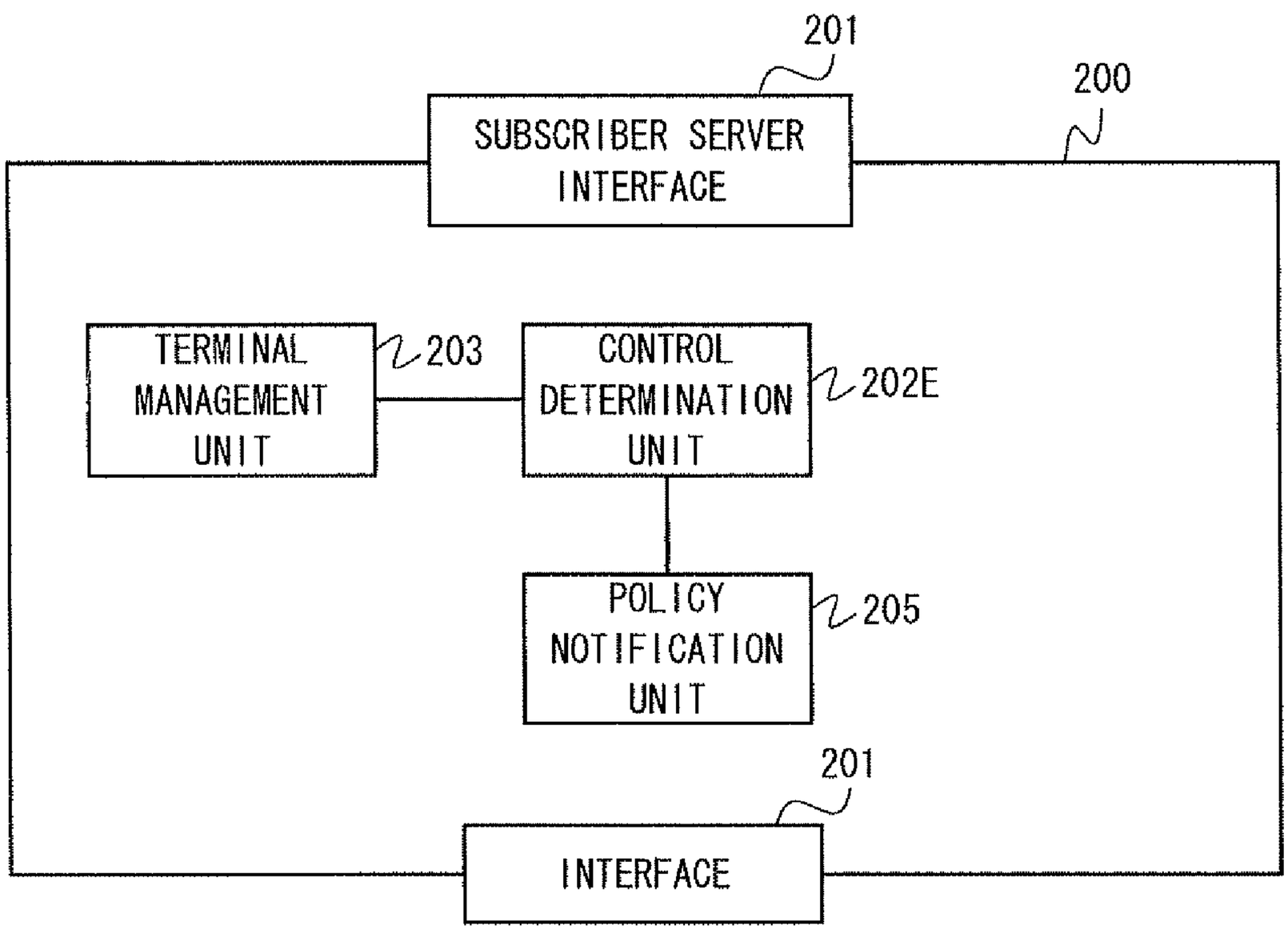
201
200
SUBSCRIBER SERVER INTERFACE
TERMINAL MANAGEMENT UNIT
203
CONTROL DETERMINATION UNIT
202E
POLICY NOTIFICATION UNIT
205
201
INTERFACE

Fig. 20

PRIMARY KEY	
ITEM	VALUE
SUBSCRIBER ID	0001
STATE CONTROL POLICY	
ITEM	VALUE
IDLE TRANSITION INTERVAL (sec)	120

Fig. 21

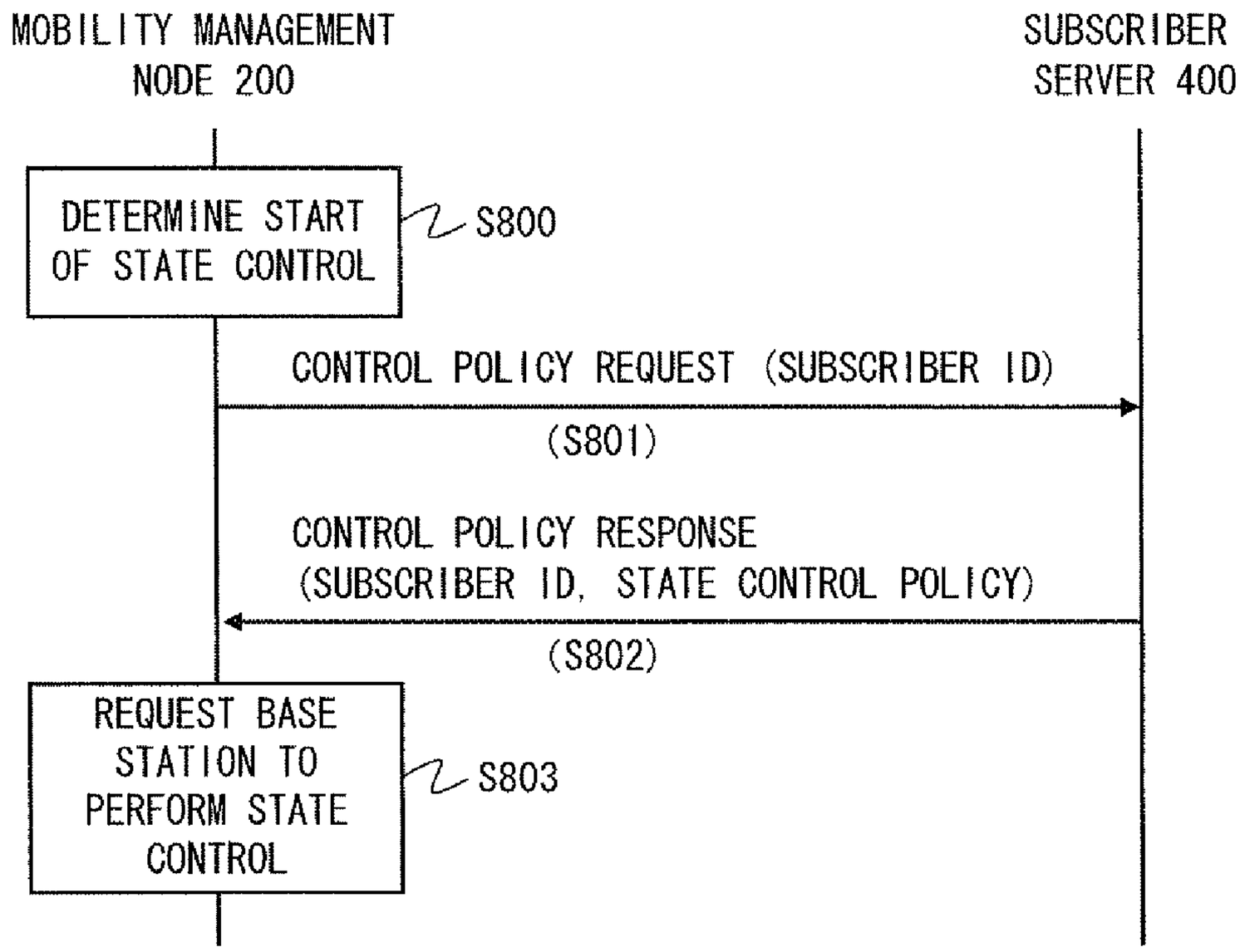

Fig. 22

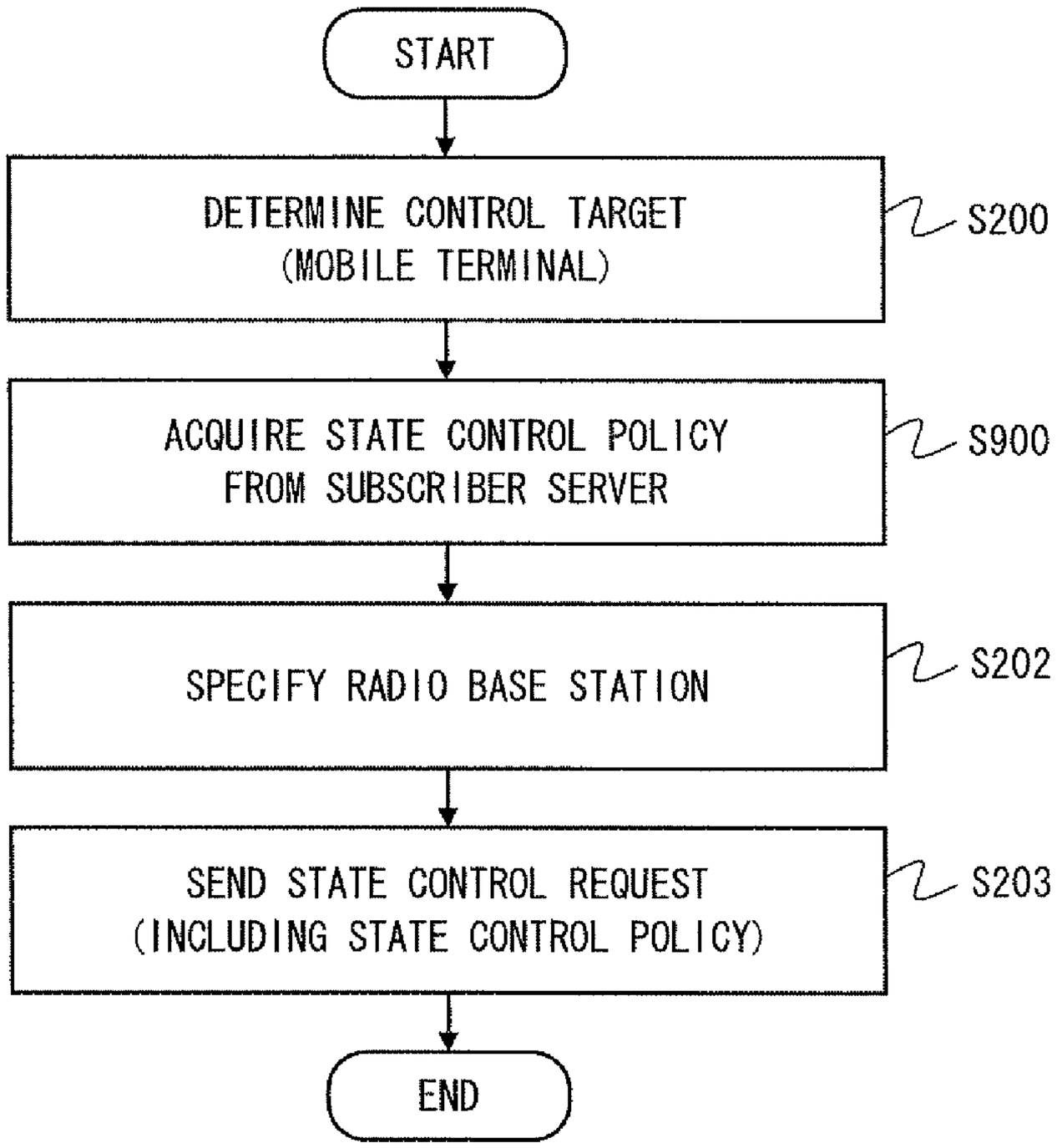
START
DETERMINE CONTROL TARGET (MOBILE TERMINAL)
S200
ACQUIRE STATE CONTROL POLICY FROM SUBSCRIBER SERVER
S900
SPECIFY RADIO BASE STATION
S202
SEND STATE CONTROL REQUEST (INCLUDING STATE CONTROL POLICY)
S203
END

Fig. 23

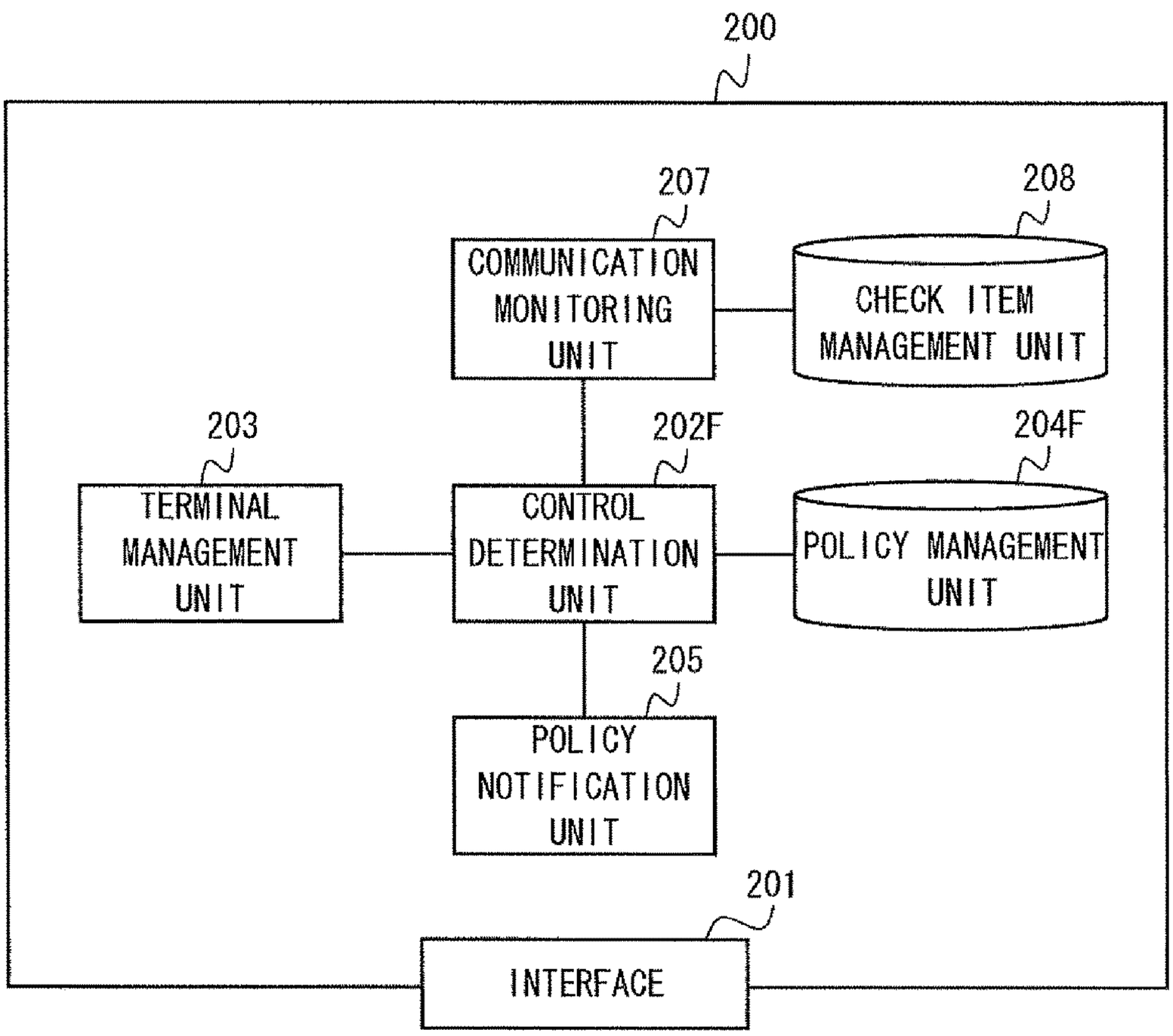
200
207
COMMUNICATION MONITORING UNIT
208
CHECK ITEM MANAGEMENT UNIT
203
TERMINAL MANAGEMENT UNIT
202F
CONTROL DETERMINATION UNIT
204F
POLICY MANAGEMENT UNIT
205
POLICY NOTIFICATION UNIT
201
INTERFACE

Fig. 24

CHECK ITEM	CHECK ID
10 TIMES OR MORE OF STATE TRANSITION WITHIN 10 MINUTES	0001
NO MOVEMENT FROM THE SAME BASE STATION FOR 30 MINUTES OR MORE	0002

Fig. 25

PRIMARY KEY	
ITEM	VALUE
CHECK ID	0001
STATE CONTROL POLICY	
ITEM	VALUE
IDLE TRANSITION INTERVAL (sec)	120

Fig. 26

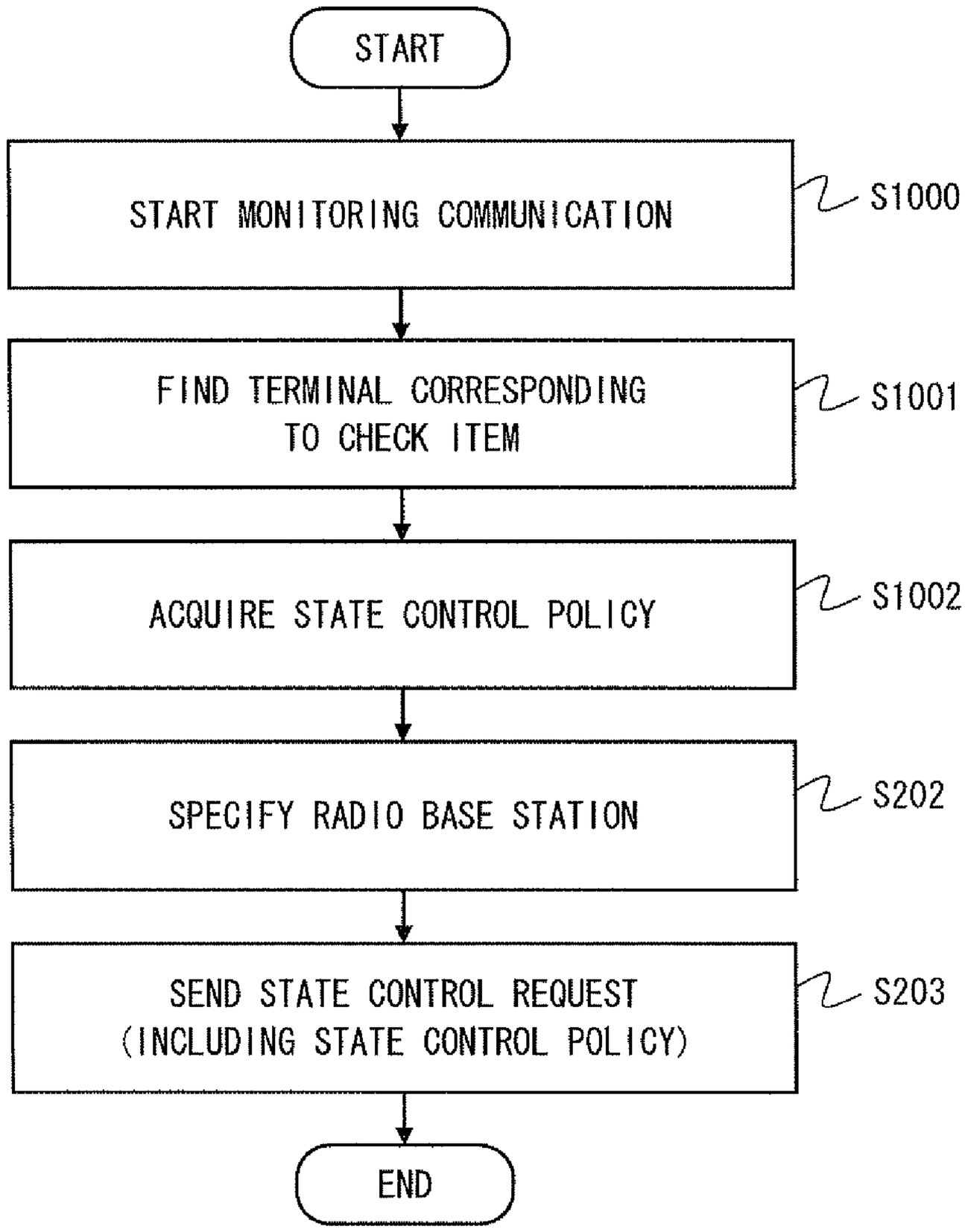
START
START MONITORING COMMUNICATION
S1000
FIND TERMINAL CORRESPONDING TO CHECK ITEM
S1001
ACQUIRE STATE CONTROL POLICY
S1002
SPECIFY RADIO BASE STATION
S202
SEND STATE CONTROL REQUEST (INCLUDING STATE CONTROL POLICY)
S203
END

Fig. 27

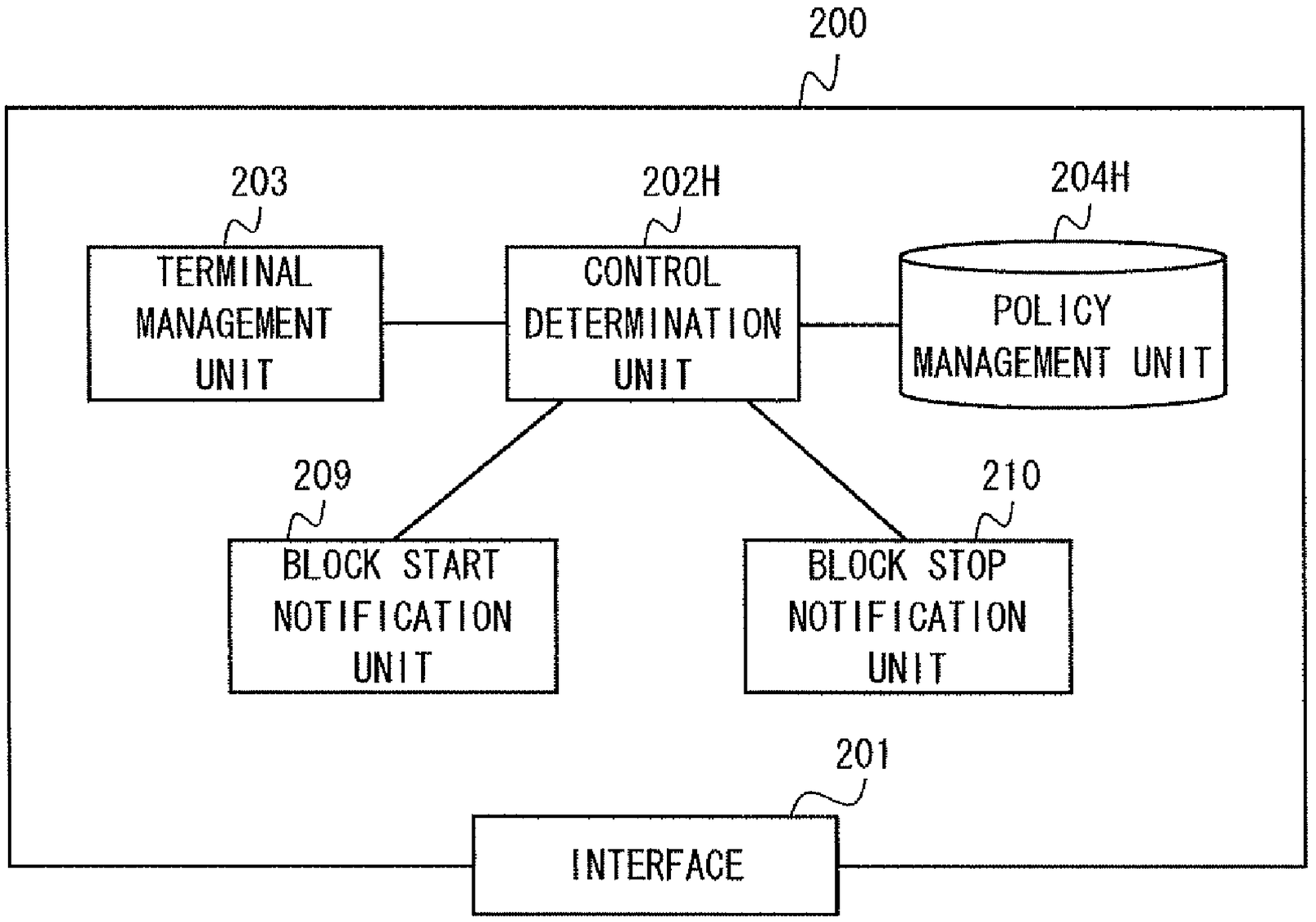
200
203
TERMINAL MANAGEMENT UNIT
202H
CONTROL DETERMINATION UNIT
204H
POLICY MANAGEMENT UNIT
209
BLOCK START NOTIFICATION UNIT
210
BLOCK STOP NOTIFICATION UNIT
201
INTERFACE

Fig. 28

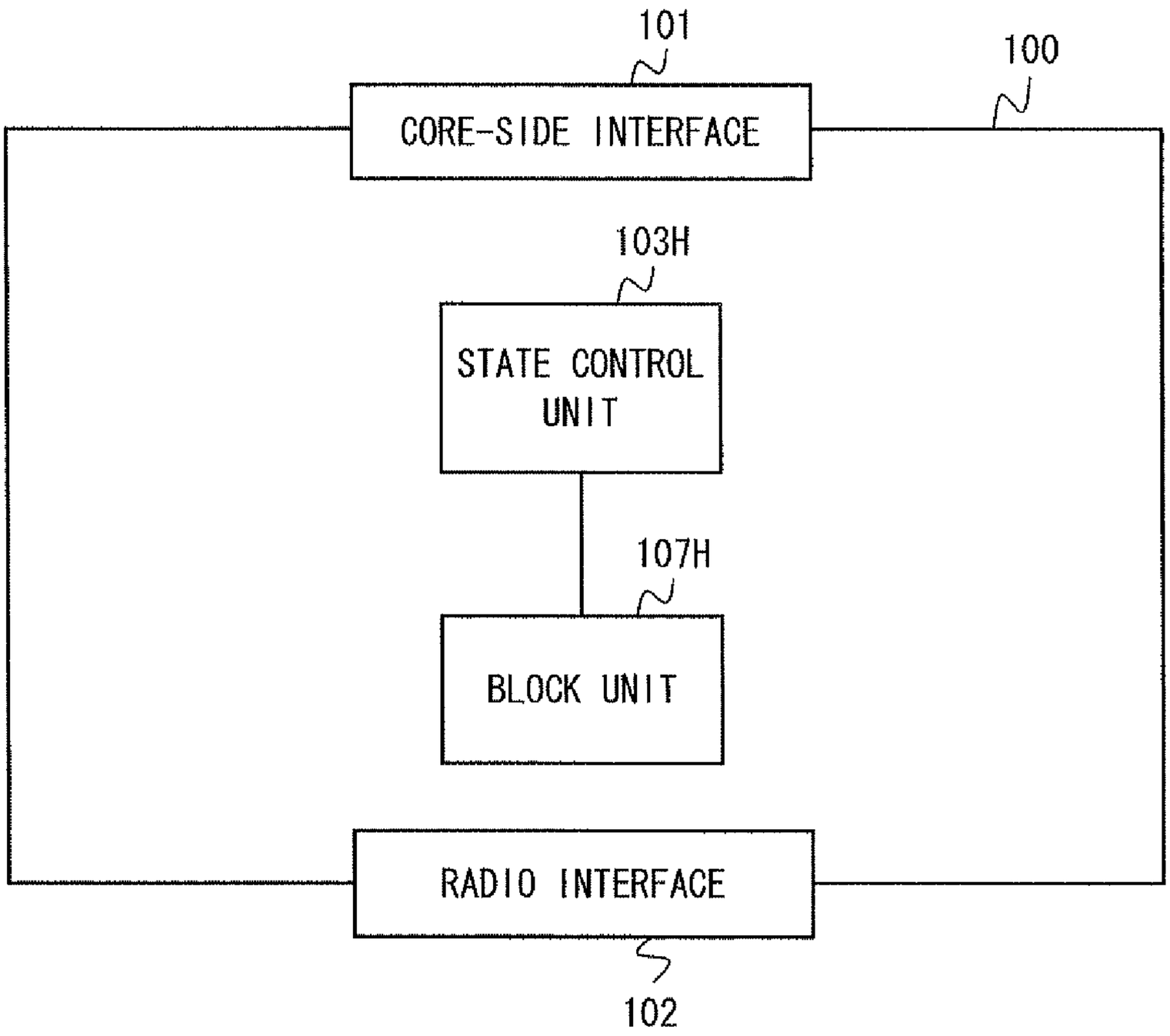

Fig. 29

PRIMARY KEY	
ITEM	VALUE
CONTROL TARGET TERMINAL (TERMINAL ID)	0001
STATE CONTROL POLICY	
ITEM	VALUE
BLOCK POLICY	TERMINAL REQUEST O&M SERVER REQUEST

Fig. 30

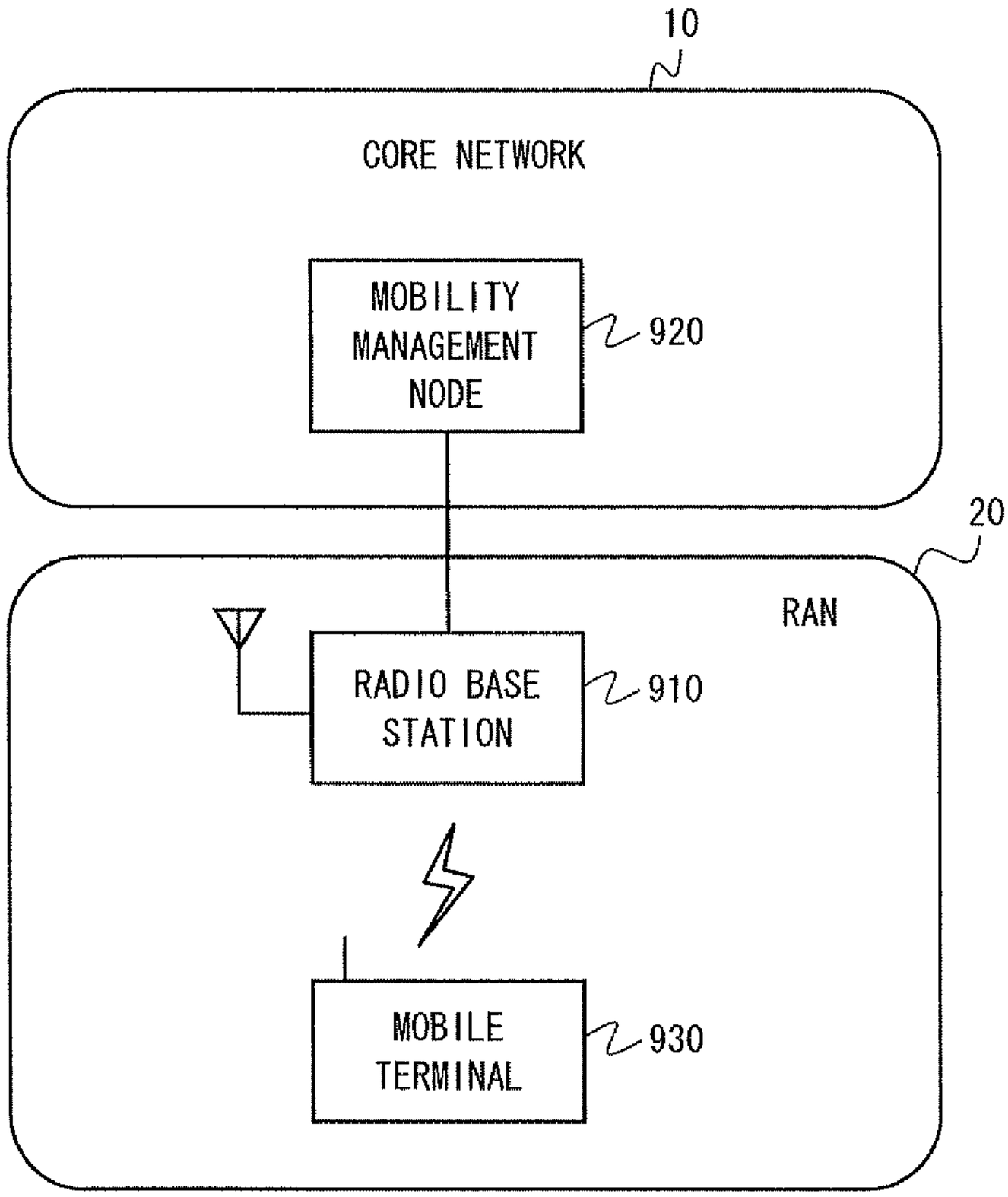
10
CORE NETWORK
MOBILITY MANAGEMENT NODE
920
20
RAN
RADIO BASE STATION
910
MOBILE TERMINAL
930

Fig. 31

MOBILE COMMUNICATIONS SYSTEM, CONTROL APPARATUS, POLICY SUPPLY SYSTEM, STATE TRANSITION CONTROL METHOD, AND POLICY SUPPLY METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a National Stage of International Application No. PCT/JP2011/006475 filed Nov. 21, 2011, claiming priority based on Japanese Patent Application No. 2011-000992 filed Jan. 6, 2011, the contents of all of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

The present invention relates to a mobile communications system that has been studied in the 3GPP (3rd Generation Partnership Project), 3GPP2, WiMAX Forum, and the like, and more particularly, relates to a method for controlling a state transition of a mobile terminal between a CONNECTED state and an IDLE state.

BACKGROUND ART

FIG. **4** is a block diagram showing a general configuration example of a mobile communications system. In FIG. **4**, nodes having nothing to do with the Background Art section, and nodes unnecessary for explanation are omitted. In FIG. **4**, a core network **10** is managed by an operator that mainly provides mobile communication services. The core network **10** is, for example, a packet switching network (EPC (Evolved Packet Core)) of an EPS (Evolved Packet System) or a packet switching core network of a UMTS (Universal Mode Telecommunications System) of the 3GPP, a packet switching core network of CDMA2000 of the 3GGP2, or a packet switching core network of a CSN (Connectivity Service Network) of the WiMAX Forum.

A radio access network **20** includes a radio base station **910** and a mobile terminal **930**. The radio base station **910** has a function of connecting to the mobile terminal **930** by a radio access technique. The core network **10** includes a mobility management node **200**. The mobility management node **920** performs mobility management and authentication (security control) of the terminal **930** during radio access, and manages setting processes and control signals for a user data transfer path between the core network **10** and the radio base station **910**. The mobile terminal **930** has a radio interface, and connects to the radio base station **910** by the radio access technique and also connects to the core network **10**.

In the EPS of the 3GPP, the radio base station **910** corresponds to an eNB (Enhanced NodeB); the mobility management node **920** corresponds to an MME (Mobility Management Entity); and the mobile terminal **930** corresponds to a UE (User Equipment). As the radio access technique, LTE (Long Term Evolution) is employed.

In the UMTS of the 3GPP, the radio base station **910** corresponds to functions of an RNC (Radio Network Controller) and an NB (NodeB). The mobility management node **200** corresponds to an SGSN (Serving GPRS Support Node), and the mobile terminal **300** corresponds to the UE (User Equipment). As the radio access technique, W-CDMA (Wideband Code Division Multiple Access) is employed.

In the CDMA2000 system of the 3GGP2, the radio base station **100** corresponds to a BS (Base Station); the mobility management node **200** corresponds to a PDNS (Packet Data Serving Node); and the mobile terminal **300** corresponds to an MS (Mobile Station). As the radio access technique, EV-DO (Evolution-Data Optimized) is employed.

In a communication system of the WiMAX Forum, the radio base station **100** corresponds to functions of an ASN-GW (Access Service Network Gateway) and the BS (Base Station). The mobility management node **200** corresponds to an HA (Home Agent), and the mobile terminal **300** corresponds to an MS (Mobile Station). As the radio access technique, WiMAX is employed.

Aspects and embodiments of the present invention herein described are not dependent on architectures of mobile communications systems. Accordingly, aspects and embodiments of the present invention can be applied to mobile communications systems standardized in the 3GPP, 3GPP2, and WiMAX Forum. However, the following description will be made with reference to the mobile communications system of the EPS in the 3GPP so as to describe configurations and operations according to aspects and embodiments of the present invention in detail.

In FIG. **31**, a radio control including allocation of resources (channels) in a radio section between the mobile terminal **930** and the radio base station **910** is carried out in an RRC (Radio Resource Control) layer, and exchange of control messages and packet communication between the mobile terminal **300** and the core network **10**, for example, are carried out in a NAS (Non-Access Stratum) layer which is upper layer of the RRC.

In RRC layer, there are two states of RRC_IDLE and RRC_CONNECTED. In the RRC_CONNECTED state, the radio base station **910** holds information (i.e., RRC context) on an RRC connection between the mobile terminal **930** and the radio base station **910**, and transmission and reception of user data in the radio section between the mobile terminal **930** and the radio base station **910** are thereby enabled. On the other hand, in the RRC_IDLE state, the radio base station **100** releases the information (RRC context) on the RRC connection of the mobile terminal **300**, discontinuous reception (DRX) that is configured by NAS is indicated to the mobile terminal **300**, and therefore the mobile terminal **300** is able to receive a paging signal.

During the discontinuous reception, a radio communication unit included in the mobile terminal **930** is activated to perform a reception operation in accordance with time slots to be received by the mobile terminal **930**. During the other time periods, the radio communication unit is brought into a standby state (power-off). Thus, the discontinuous reception provides a great effect of power saving in the mobile terminal **930**.

In the NAS layer, there are two states of ECM (EPS Connection Management)_IDLE and ECM_CONNECTED. In the ECM-CONNECTED state, a NAS connection is established between the mobile terminal **930** and the mobility management node **920**. The mobility management node **920** accurately recognizes the position of the mobile terminal **930** (i.e., recognizes a radio base station to which the mobile terminal is connected) by using the NAS connection, and performs a handover process when the mobile terminal **930** moves between base stations. On the other hand, the ECM_IDLE state is a state in which the NAS connection is not established between the mobile terminal **930** and the mobility management node **920**. In the ECM_IDLE state, the mobility management node **920** performs mobility management of the mobile terminal **930** in units of tracking areas that each includes a plurality of radio base stations. Accordingly, even when the mobile terminal **930** in the ECM_IDLE state moves between radio base stations, no handover pro-

cess occurs. When the mobile terminal **930** returns to the ECM_CONNECTED state from the ECM_IDLE state, the mobile terminal **930** needs to be synchronized with the core network **10** (i.e., needs to perform location registration).

When the mobile terminal **930** is in ECM_IDLE state and the mobility management node **920** performs the mobility management of the mobile terminal **930** in units of tracking areas, there is no need to perform the handover process even when the mobile terminal **930** moves between radio base stations. This provides an advantage of reducing a load on the core network (including the mobility management node **200**).

It can be said that the states (CONNECTED or IDLE) related to connections of the RRC layer and the NAS layer are synchronized. This is because it is necessary to establish a connection in the RRC layer (come into the RRC_CONNECTED state) so as to establish a connection in the NAS layer (come into the ECM_CONNECTED state), and the connection in the NAS layer is established simultaneously with the establishment of the connection in the RRC layer. This is also because when the connection in one of the RRC layer and the NAS layer is released (transits to the IDLE state), the connection in the other layer is also released (transits to the IDLE state).

When the NAS layer transits from the ECM_CONNECTED state to the ECM_IDLE state, an S1 Release Procedure is executed. As an example of a trigger for executing the S1 Release Procedure is a release of RRC-connection (a transition to RRC_IDLE state). When the S1 Release Procedure is executed in the state where the connection in the RRC layer is established (RRC_CONNECTION state), the connection in the RRC layer is also released (transits to RRC_IDLE). That is, when the RRC layer and the NAS layer transit to the IDLE state, the S1 Release Procedure is executed.

On the other hand, when the RRC layer and the NAS layer transit to the CONNECTED state from the IDLE state, a Service Request Procedure is executed. When the Service Request Procedure is executed, the NAS connection and the RRC connection are established.

Here, the definition of terms "CONNECTED state" and "IDLE state" which are used in this specification and the claims is described. The term "IDLE state" refers to a state in which a mobile terminal does not perform signaling for session management and mobility management with a core network, and radio resources in a radio access network such as E-UTRAN are released, as in the case of the ECM_IDLE state and the RRC_IDLE state of the 3GPP described above. On the other hand, the term "CONNECTED state" refers to a state in which radio resources for sending and receiving control signals (control messages) for at least session management and mobility management between a mobile terminal and a core network are secured in a radio access network, and the control signals (control messages) can be sent and received between the mobile terminal and the core network, as in the case of the ECM_CONNECTED state and the RRC_CONNECTED state of the 3GPP described above. That is, it is only necessary that the "CONNECTED state" is a state in which a mobile terminal is connected to a core network so as to enable transmission and reception of control signals (control messages) for at least session management and mobility management. In other words, the "CONNECTED state" does not require a state in which a bearer for transferring user data between a mobile terminal and an external packet data network (PDN) is established.

CITATION LIST

Non Patent Literature

Non Patent Literature 1: 3GPP TS 23.401 V10.0.0 (2010-06), "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (Release 10)", Section 4.6.3, Section 5.3.4, and Section 5.3.5, June, 2010

Non Patent Literature 2: 3GPP TS 36.331 V9.1.0 (2009-12), "Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol specification (Release 9)", Section 4.2.1, Section 5.3.8, and Section 5.3.9, January, 2010

Non Patent Literature 3: 3GPP TS 24.301 V9.1.0 (2009-12), "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3", Section 5.3.1.2, December, 2009

SUMMARY OF INVENTION

Technical Problem

As described in the Background Art section, when the radio connection of the mobile terminal **930** is released (transits to RRC_IDLE) in a radio resource management layer between the mobile terminal **930** and the radio base station **910**, the S1 Release Procedure for releasing the connection of the upper layer (NAS layer) is executed as well. Also when the RRC layer transits from the RRC_IDLE state to the RRC_CONNECTED state, the Service Request Procedure for establishing the connection of the upper layer (NAS layer) is executed as well. Upon execution of the S1 Release Procedure or the Service Request Procedure, a plurality of signalings is exchanged between the mobile terminal **930** and the core network **10**.

Many of recent mobile terminals including smartphones, which place importance on power saving, operate to release a radio connection immediately when there is no communication, and to cause the state of each of the radio resource management layer and the upper layer to transit to the IDLE state. Meanwhile, as a tendency for application programs that run on a mobile terminal, the number of application programs that periodically connects with a server to send and receive information is increasing. As a result, the recent mobile terminals operate to transit to the IDLE state immediately after completion of communication and then transit to the CONNECTED state immediately for an application that periodically performs communication. That is, the phenomenon in which a mobile terminal repeatedly transits between the IDLE state and the CONNECTED state occurs in many cases. This causes a problem that the number of signalings to be processed by the core network **10** increases, resulting in an increase in load on the core network **10**.

As a method for reducing the number of signalings caused due to repetition of the state transition of the mobile terminal **930**, it is possible to execute control for adjusting a timing of the transition from the CONNECTED state to the IDLE state in the mobile terminal **930**. If the state transition of the mobile terminal **930** can be optimized, a reduction in the number of signalings caused due to repetition of state transition can be expected. However, in the present specifications for mobile communications systems, such as the 3GPP, it is impossible for the core network **10** (for example, the mobility management node **920**) to control the timing of the state transition of the mobile terminal **930** between the CONNECTED state and the IDLE state (hereinafter referred to as "CONNECTED-IDLE transition"). On the other hand,

when a state transition request arrives from the mobile terminal **930**, the core network **10** accepts the state transition request. That is, there is a problem that it is impossible for the core network **10** to proactively (i.e., based on the determination by the core network **10**) perform control related to the CONNECTED-IDLE transition of the mobile terminal **930**, such as control for changing a time interval for the mobile terminal **930** to transit from the CONNECTED state to the IDLE state, or control for blocking the state transition request from the mobile terminal **930**, for example. In other words, there is a problem that the core network **10** cannot control the timing of the CONNECTED-IDLE transition of the mobile terminal **930**.

It is an object of the present invention to provide a mobile communications system, a control apparatus, a policy supply system, a state transition control method, a policy supply method, and a program, which contribute to reducing, based on the determination by the core network **10**, the number of signalings that are caused due to repetition of the state transition of the mobile terminal **930** (i.e., CONNECTED-IDLE transition) and are to be processed by the core network **10**.

Solution to Problem

A first aspect of the present invention includes a mobile communications system. The mobile communications system includes: a radio base station that is arranged in a radio access network and performs radio communication with a mobile terminal; a control apparatus arranged in the radio access network; and a policy supply system arranged in a core network. The policy supply system is configured to supply the control apparatus with a first control policy for use in control related to a state transition of the mobile terminal between a CONNECTED state and an IDLE state. The control apparatus is configured to perform the control related to the state transition for the mobile terminal based on the first control policy.

A second aspect of the present invention includes a control apparatus that is arranged in a radio access network including a radio base station and is capable of communicating with a policy supply system arranged in a core network. The control apparatus includes an interface unit and a control unit. The interface unit is configured to acquire, from the policy supply system, a first control policy for use in control related to a state transition between a CONNECTED state and an IDLE state of a mobile terminal connected to the radio base station. The control unit is configured to perform the control related to the state transition for the mobile terminal based on the first control policy.

A third aspect of the present invention is a policy supply system that is arranged in a core network and is capable of communicating with a control apparatus arranged in a radio access network including a radio base station. The policy supply system includes a determination unit and a notification unit. The determination unit is configured to determine, from among at least one mobile terminal connected to the radio base station, a control target terminal that is subjected to control related to a state transition between a CONNECTED state and an IDLE state, and to determine a first control policy to be applied to the control related to the state transition for the control target terminal. The notification unit is configured to notify the control apparatus of a first control request for requesting execution of the control related to the state transition, the first control request including the first control policy.

A fourth aspect of the present invention includes a control method for a state transition of a mobile terminal connected to a radio base station, the control method being carried out by a control apparatus arranged in a radio access network including the radio base station. The control method includes the steps of:

(a) acquiring, from a policy supply system arranged in a core network, a first control policy for use in control related to a state transition between a CONNECTED state and an IDLE state of a mobile terminal connected to the radio base station; and

(b) performing the control related to the state transition for the mobile terminal based on the first control policy.

A fifth aspect of the present invention includes a policy supply method to be carried out by a policy supply system that is arranged in a core network and is capable of communicating with a control apparatus arranged in a radio access network including a radio base station. The method includes the steps of:

(a) determining, from among at least one mobile terminal connected to the radio base station, a control target terminal that is subjected to control related to a state transition between a CONNECTED state and an IDLE state;

(b) determining a first control policy to be applied to the control related to the state transition for the control target terminal; and

(c) notifying the control apparatus of a first control request for requesting execution of the control related to the state transition, the first control request including the first control policy.

A sixth aspect of the present invention is a program for causing a computer to execute the method according to the fourth aspect of the present invention or the method according to the fifth aspect of the present invention described above.

Advantageous Effects of Invention

According to the above-described aspects of the present invention, it is possible to provide a mobile communications system, a control apparatus, a policy supply system, a state transition control method, a policy supply method, and a program, which contribute to reducing the number of signalings that are caused due to repetition of the state transition of a mobile terminal (i.e., CONNECTED-IDLE transition) and are to be processed by the core network, based on the determination by the core network.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram showing a configuration example of a mobile communications system in a first embodiment;

FIG. **2** is a diagram showing a configuration example of a mobility management node in the first embodiment;

FIG. **3** is a table showing an example of a state control policy in the first embodiment;

FIG. **4** is a diagram showing a configuration example of a radio base station in the first embodiment;

FIG. **5** is a sequence diagram showing a flow of processes in which the mobility management node requests the radio base station to perform a state control of a mobile terminal in the first embodiment;

FIG. **6** is a flowchart showing an operation example when the mobility management node in the first embodiment sends a state control request;

FIG. **7** is a flowchart showing an operation example when the radio base station in the first embodiment executes a state control for the mobile terminal;

FIG. **8** is a diagram showing a configuration example of a mobility management node in a second embodiment;

FIG. **9** is a diagram showing a configuration example of a radio base station in the second embodiment;

FIG. **10** is a table showing an example of a state control policy in the second embodiment;

FIG. **11** is a flowchart showing a process example when the radio base station receives a state control request from the mobility management node in the second embodiment;

FIG. **12** is a diagram showing a configuration example of a mobility management node in a third embodiment;

FIG. **13** is a diagram showing a configuration example of a radio base station in the third embodiment;

FIG. **14** is a table showing an example of a state control policy in the third embodiment;

FIG. **15** is a flowchart showing a process example when the radio base station receives a state control request from the mobility management node in the third embodiment;

FIG. **16** is a diagram showing a configuration example of a mobility management node in a fourth embodiment;

FIG. **17** is a sequence diagram showing a flow of processes to start a state control for a mobile terminal when the mobile terminal starts connection and handover to a radio base station;

FIG. **18** is a flowchart showing a process example when the mobility management node receives a connection notification of the mobile terminal from the radio base station in the fourth embodiment;

FIG. **19** is a diagram showing a configuration example of a mobile communications system in a fifth embodiment;

FIG. **20** is a diagram showing a configuration example of a mobility management node in the fifth embodiment;

FIG. **21** is a table showing an example of a state control policy in the fifth embodiment;

FIG. **22** is a sequence diagram showing a flow of processes when the mobility management node determines a state control for a specific mobile terminal in the fifth embodiment;

FIG. **23** is a flowchart showing a process example when the mobility management node starts the state control for the specific mobile terminal in the fifth embodiment;

FIG. **24** is a diagram showing a configuration example of a mobility management node in a sixth embodiment;

FIG. **25** is a table showing an example of check items that are managed by a check item management unit **208** in the sixth embodiment;

FIG. **26** is a table showing an example of a state control policy in the sixth embodiment;

FIG. **27** is a flowchart showing a process example during a period from the time when the mobility management node starts monitoring communication of a mobile terminal to the time when the mobility management node starts a state control for a specific mobile terminal in the sixth embodiment;

FIG. **28** is a diagram showing a configuration example of a mobility management node in a seventh embodiment;

FIG. **29** is a diagram showing a configuration example of a radio base station in the seventh embodiment;

FIG. **30** is a table showing an example of a state control policy in the seventh embodiment; and

FIG. **31** is a diagram showing a configuration example of a mobile communications system according to a background art.

DESCRIPTION OF EMBODIMENTS

Hereinafter, embodiments to which the present invention is applied will be described in detail with reference to the drawings. In the drawings, identical or corresponding elements are denoted by the same reference numerals, and a redundant explanation thereof is omitted as appropriate for clarification of the explanation.

First Embodiment

FIG. **1** is a block diagram showing a configuration example of a mobile communications system according to this embodiment. The system shown in FIG. **1** includes a mobility management node **200***t* arranged in a core network **10**, a radio base station **100**, and a mobile terminal **300**. An arrangement and basic functions and operations of the mobility management node **200**, the radio base station **100**, and the mobile terminal **300** are similar to those of the mobility management node **920**, the radio base station **910**, and the mobile terminal **930** which are shown in FIG. **31**.

The mobility management node **200** is configured to be able to acquire a policy related to control for CONNECTED-IDLE transition of the mobile terminal **300**. Control for states of the mobile terminal **300** including control for CONNECTED-IDLE transition is hereinafter referred to as "state control". Policies related to "state control" for the mobile terminal **300** are referred to as "a state control policy". The state control policy is individually determined for each mobile terminal **300**. The state control policy may be managed by the mobility management node **200** itself, or may be managed by another node that is accessible from the mobility management node **200**. The state control policy is used to control the adjustment of a timing of a state transition of the mobile terminal **300** between a CONNECTED state and an IDLE state. The state control policy includes, for example, at least one of designation of a time interval in which the mobile terminal **300** transits from the CONNECTED state to the IDLE state (hereinafter referred to as "IDLE transition interval") and designation as to whether or not to block a state transition request from the mobile terminal **300** or an O&M server.

Further, the mobility management node **200** is configured to be able to determine a terminal as a state control target from among a plurality of mobile terminals **300** connected to a plurality of radio base stations **100** under management of the mobility management node **200**. A number of variations of the method for determining a control target terminal and of the timing of the determination can be made. Specific examples of the method for determining a control target terminal and the timing of the determination will be described in detail in second and subsequent embodiments described later. For example, the mobility management node **200** may determine a control target terminal according to a load status of signaling of the core network **10**.

The mobility management node **200** notifies the radio base station **100**, to which the terminal **300** is connected, of the state control policy applied to the terminal **300** which is determined as the control target. The notification of the state control policy to the base station **100** may be performed by sending, from the mobility management node **200** to the base station **100**, a state control request message that includes a terminal ID of the terminal **300** determined as the control target and the state control policy, for example.

The radio base station **100** is configured to be able to receive, from the mobility management node **200**, the terminal ID, which allows identification of the terminal **300**

determined as the control target, and the state control policy. Based on the received state control policy, the radio base station **100** performs a state control (i.e., control for CONNECTED-IDLE transition) for the terminal **300** determined as the control target. As a specific example, the base station **100** may change the "IDLE transition interval" which is applied to the mobile terminal **300** determined as the control target. Further, the base station **100** may start blocking of the state transition request having arrived from the mobile terminal **300** determined as the control target.

According to the mobility management node **200** and the radio base station **100** of this embodiment, the core network **10** can proactively control the timing of the CONNECTED-IDLE transition of the mobile terminal **300** based on the determination by the core network **10** (i.e., the mobility management node **200**). Accordingly, the number of signalings which are caused due to repetition of the CONNECTED-IDLE transition of the mobile terminal **300** and which are to be processed by the core network **10** can be reduced based on the determination by the core network **10**.

The configuration and operation of the mobility management node **200** and the radio base station **100** in this embodiment will be described below. FIG. **2** is a block diagram showing a configuration example of the mobility management node **200**. The mobility management node **200** shown in FIG. **2** includes an interface **201**, a control determination unit **202**, a terminal management unit **203**, a policy management unit **204**, and a policy notification unit **205**. Note that FIG. **2** shows components in a major portion necessary for explanation of this embodiment, and the illustration of the other portion is omitted.

The interface **201** is an interface available for communication with the radio base station **100**. The interface **201** is used for transmission and reception of control signals (messages) related to the state control of the mobile terminal **300**.

The control determination unit **202** determines a mobile terminal as a state control target from among the plurality of mobile terminals **300** connected to the plurality of radio base stations **100**. Further, the control determination unit **202** acquires a control policy corresponding to the control target terminal from the policy management unit **204**, and notifies the radio base station **100**, to which the control target terminal is connected, of the terminal ID of the control target terminal and the control policy applied thereto. The terminal ID herein described is an ID that allows unique identification of the mobile terminal **300** on the mobile communications system. Specific examples of the ID include IMSI (International Mobile Subscriber Identity), IMEI (International Mobile Equipment Identity), and GUTI (Globally Unique Temporary ID). The control determination unit **202** may acquire the terminal ID of the terminal in the case of determining the control target terminal.

A number of variations of the method for specifying the control target terminal by the control determination unit **202** can be made. Further, a number of variations of the timing of determining the control target terminal can be made as follows. That is, for example, the control is started at the timing when a mobile terminal has just connected, or the communication characteristics of the mobile terminal are monitored and the control is started for the mobile terminal that satisfies a certain condition. A specific method for specifying the control target terminal will be described in the second and subsequent embodiments.

The terminal management unit **203** is a function unit that performs mobility management of the mobile terminal **300**, and recognizes the mobile terminals **300** that have connected (attached) to a plurality of radio base stations **100**. Upon receiving, from the control determination unit **202** using the terminal ID of the control target terminal, an inquiry as to the base station **10** to which the control target terminal is currently connected, the terminal management unit **203** notifies the control determination unit **202** of the base station ID of the radio base station **100** to which the mobile terminal **300** corresponding to the terminal ID is currently connected.

The policy management unit **204** stores the state control policy related to the state transition of the mobile terminal **300**. The state transition policy in this embodiment is recorded for each mobile terminal, and includes a description of the IDLE transition interval of the mobile terminal **300**. FIG. **3** shows an example of the state control policy managed by the policy management unit **204**. In the example of FIG. **3**, the terminal ID of the control target terminal is configured as a primary key, and the state control policy corresponding to the primary key is managed. In the example of FIG. **3**, the IDLE transition interval is registered as a state control policy.

Upon acquiring, from the control determination unit **202**, the terminal ID of the control target terminal, the state control policy to be applied to the control target terminal, and the base station ID of the radio base station **100** to which the control target terminal is currently connected, the policy notification unit **205** sends a state control request to the radio base station **100** corresponding to the base station ID. The state control request includes the terminal ID of the control target terminal and the state control policy.

FIG. **4** is a block diagram showing a configuration example of the radio base station **100** in this embodiment. The radio base station **100** shown in FIG. **4** includes a core-side interface **101**, a radio interface **102**, a state control unit **103**, a monitoring unit **104**, a timer function unit **105**, and an IDLE transition start unit **106**. Note that FIG. **4** shows components in a major portion necessary for explanation of this embodiment, and the illustration of the other portion is omitted.

The core-side interface **101** is an interface available for communication with the mobility management node **200** arranged in the core network **10**. The interface **101** is used for reception of the state control request from the mobility management node **200**, and for transmission of a response to the mobility management node **200**.

The radio interface **102** is an interface for performing radio communication between the radio base station **100** and the mobile terminal **300**.

The state control unit **103** receives the state control request sent from the mobility management node **200** via the core-side interface **101**. Further, the state control unit **103** has a function of executing a state control (control for CONNECTED-IDLE transition) for the control target terminal by activating the monitoring unit **104**, the timer function unit **105**, and the IDLE transition start unit **106** based on the terminal ID and the state control policy which are included in the state control request. The state control operation performed by the base station **100** including the operation of the state control unit **103** will be described in detail later.

The monitoring unit **104** has a function of monitoring a communication state of a monitoring target terminal (i.e., monitoring whether to transmit or receive data). The monitoring unit **104** receives, from the state control unit **103**, the terminal ID of the mobile terminal **300** as the monitoring target, and monitors the communication state of the mobile terminal **300** corresponding to the received terminal ID. After confirming the state in which the monitoring target terminal is not performing data communication, the moni-

toring unit **104** notifies the state control unit **103** of the terminal ID and information indicating the state in which data communication is not performed. Further, after confirming that data communication is resumed from the state in which the monitoring target terminal is not performing data communication, the monitoring unit **104** notifies the state control unit **103** of the terminal ID and information indicating that data communication is resumed.

The timer function unit **105** has a function of measuring the IDLE transition interval for each mobile terminal. Upon receiving, from the state control unit **103**, the terminal ID of the mobile terminal **300** to be measured and the IDLE transition interval, the timer function unit **105** secures a timer for the mobile terminal corresponding to the acquired terminal ID in a memory. This terminal ID is the terminal ID of the control target terminal which is notified from the mobility management node **200**. This IDLE transition interval is the IDLE transition interval included in the state control policy notified from the mobility management node **200**. Further, upon receiving a timer start request including the terminal ID from the state control unit **103**, the timer function unit **105** starts a measurement using the timer for the mobile terminal corresponding to the terminal ID. Then, when the timer for the mobile terminal reaches the configured IDLE transition interval, the timer function unit **105** sends to the state control unit **103** an expiration notification including the terminal ID of the mobile terminal after expiration of the interval.

Upon receiving the IDLE transition start request including the terminal ID from the state control unit **103**, the IDLE transition start unit **106** starts a process for causing the mobile terminal **300** corresponding to the received terminal ID to transit from the CONNECTED state to the IDLE state. A specific example of the process for causing the mobile terminal **300** to transit from the CONNECTED state to the IDLE state is S1 RELEASE PROCEDURE.

Subsequently, a flow of processes in which the mobility management node **200** requests the radio base station **100** to perform the state control of the mobile terminal **300** will be described with reference to the sequence diagram of FIG. **5**.

First, in step S**100**, the mobility management node **200** determines a mobile terminal as a state control target, acquires a state control policy to be applied to the control target terminal, and specifies the radio base station **200** to which the control target terminal is currently connected.

In step S**101**, the mobility management node **200** sends, to the radio base station **100** to which the control target terminal has attached, the state control request including the terminal ID of the control target terminal and the state control policy to be applied to the control target terminal.

In step S**102**, the radio base station **100** starts the state control based on the terminal ID and the state control policy which are received from the mobility management node **200**.

In step S**103**, the radio base station **100** notifies the mobility management node **200** of a state control response indicating that the execution of the control is started.

Referring next to the flowchart of FIG. **6**, an operation example when the mobility management node **200** sends the state control request to the radio base station **100** will be described. First, in step S**200**, the control determination unit **202** determines the start of the state control for a specific mobile terminal (i.e., control target terminal). The control determination unit **202** acquires the terminal ID of the control target terminal according to the determination of the control target terminal. In step S**201**, the control determination unit **202** acquires, from the policy management unit **204**, the state control policy corresponding to the terminal ID of the control target terminal.

In step S**202**, the control determination unit **202** sends an inquiry to the terminal management unit **203** by using the terminal ID of the control target terminal, thereby receiving the base station ID of the radio base station **100** to which the control target terminal is currently connected. In step S**203**, the control determination unit **202** notifies the policy notification unit **205** of the terminal ID of the control target terminal, the state control policy, and the base station ID of the radio base station to which the control target terminal is currently connected. The policy notification unit **205** sends, to the radio base station **100** corresponding to the base station ID, the state control request including the terminal ID and the control policy which are received from the control determination unit **202**.

Referring next to the flowchart of FIG. **7**, an operation example when the radio base station **100** executes the state control for the mobile terminal **100** will be described. First, in step S**300**, the state control unit **103** receives the state control request via the core-side interface **101**. In step S**301**, the state control unit **103** acquires, from the state control request, the terminal ID of the control target terminal and the IDLE transition interval, which is a parameter within the state control policy, and sets the terminal ID and the IDLE transition interval to the timer function unit **105**.

In step S**302**, the state control unit **103** notifies the monitoring unit **104** of the terminal ID of the control target terminal which is obtained from the state control request. The monitoring unit **104** starts monitoring the data communication of the mobile terminal **300** corresponding to the notified terminal ID. In step S**303**, after confirming the state in which the monitoring target terminal is not performing data communication, the monitoring unit **104** notifies the state control unit **103** of the terminal ID of this mobile terminal.

In step S**304**, the state control unit **103** notifies the timer function unit **105** of the timer start request as well as the terminal ID included in the notification received from the monitoring unit **104** in step S**303**. The timer function unit **105** starts counting the IDLE transition interval configured in step S**301** with respect to the terminal ID designated by the timer start request.

In step S**305**, the state control unit **103** monitors whether to receive from the monitoring unit **104** a notification indicating that the data communication of the mobile terminal determined as a counting target is resumed before the count of the timer function unit **105**, which is started in step S**304**, reaches the IDLE transition interval. When the data communication is not resumed before the count of the timer function unit **105** reaches the IDLE transition interval, the process proceeds to S**306**. When the data communication is resumed, the process proceeds to S**307**.

In step S**306**, the timer function unit **105** stops the timer when the count started in step S**304** reaches the IDLE transition interval, and sends to the state control unit **103** a notification indicating that the configured time interval is expired, as well as the terminal ID of the mobile terminal of the counting target.

In step S**307**, upon confirming that the data communication of the mobile terminal of the counting target is resumed, the monitoring unit **104** notifies the state control unit **103** of the terminal ID of the mobile terminal and a notification indicating resuming of data communication. Upon receiving the notification from the monitoring unit **104**, the state control unit **103** notifies the timer function unit **105** of the target terminal ID and a notification indicating that the count

time of the timer is reset. The timer function unit **105** resets the count time of the timer corresponding to the received terminal ID.

In step S**308**, upon receiving the notification indicating that the configured time interval is expired in step S**307** from the timer function unit **105**, the state control unit **103** sends to the IDLE transition start unit **106** the terminal ID notified from the timer function unit **105**. The IDLE transition start unit **106** starts a process for causing the mobile terminal **300** corresponding to the terminal ID received from the state control unit **103** to transit from the CONNECTED state to the IDLE state (i.e., IDLE transition process).

After starting the IDLE transition control in step S**308**, the base station **100** of this embodiment may repeatedly perform the step S**302** and subsequent steps shown in FIG. **3**, when the terminal **300** which has been caused to transit to the IDLE state transits to the CONNECTED state again.

According to the specific example described in this embodiment, the time period in which the mobile terminal **300** transits from the CONNECTED state to the IDLE state (i.e., IDLE transition interval) can be configured for each mobile terminal **300** from the mobility management node **200** arranged in the core network **10**.

Second Embodiment

This embodiment illustrates a modification of a specific example (that is, IDLE transition interval) of parameters designated by the state control policy described in the first embodiment. Specifically, in this embodiment, in addition to the IDLE transition interval of the mobile terminal **300**, a policy for blocking a request or an event that triggers transition of the mobile terminal **300** from the CONNECTED state to the IDLE state is added as one of the parameters of the state control policy.

FIG. **8** is a block diagram showing a configuration example of the mobility management node **200** in this embodiment. In the example of FIG. **8**, parameters included in the state control policy which is held in a policy management unit **204**B are partially different from the parameters of the state control policy which is held in the policy management unit **204** shown in FIG. **2**. The other elements shown in FIG. **8** are similar to the corresponding elements of FIG. **2**.

FIG. **9** is a block diagram showing a configuration example of the radio base station **100** in this embodiment. As compared with the configuration example shown in FIG. **4**, a block unit **107** is added in the example of FIG. **9**. The functions of a state control unit **103**B shown in FIG. **9** are partially different from the functions of the state control unit **103** shown in FIG. **4**. The other elements shown in FIG. **9** are similar to the corresponding elements of FIG. **4**.

The policy management unit **204**B of the mobility management node **200** stores the state control policy including a policy for blocking a request or an event that triggers transition of the mobile terminal **300** to the IDLE state (referred to as a block policy), as well as the IDLE transition interval of the mobile terminal **300**. FIG. **10** shows a specific example of the state control policy managed by the policy management unit **204**B. Examples of the block policy include an IDLE transition request (e.g., request for transition to RRC_IDLE) received from the mobile terminal **300**, and an IDLE transition request received from an O&M (Operations & Maintenance) server.

The state control unit **103**B of the radio base station **100** has the functions of the state control unit **103** described above with reference to FIG. **4**. Further, upon receiving the state control request from the mobility management node **200**, the state control unit **103**B notifies the block unit **107** of the terminal ID and the block policy within the state control policy contained in the received request.

The block unit **107** of the radio base station **100** blocks a request or an event that triggers transition of the mobile terminal **300** corresponding to the terminal ID to the IDLE state, based on the terminal ID and the block policy which are notified from the state control unit **103**B. The "blocking" includes "ignoring" a request or an event that triggers transition to the IDLE state, and also includes inhibiting execution of the IDLE transition process to be carried out according to the request or the event. The block unit **107** is able to block based on the block policy for each mobile terminal **300**. Upon receiving a block start request from the state control unit **103**B, the block unit **107** starts a block operation.

Referring next to the flowchart of FIG. **11**, the operation of the radio base station **100** of this embodiment will be described. FIG. **11** shows a process example when the radio base station **100** receives the state control request from the mobility management node **200** via the core-side interface **101**. Here, steps different from those shown in FIG. **7** described above will be focused and described, and the description of the same steps as those shown in FIG. **7** is omitted.

In step S**400**, the state control unit **103**B acquires the terminal ID and the block policy within the state control policy from the received state control request, and sets the terminal ID and the block policy to the block unit **107**.

In step S**401**, the state control unit **103**B notifies the block unit **107** of the block start request and the terminal ID included in the notification received from the monitoring unit **104** in step S**303**. The block unit **107** starts the block operation for the mobile terminal **300** corresponding to the notified terminal ID based on the block policy set in step S**400**.

In step S**402**, upon receiving the notification, which indicates that the configured time is expired and includes the terminal ID, from the timer function unit **105** in step S**306**, the state control unit **103**B sends a block stop request including this terminal ID to the block unit **107**. The block unit **107** receives the block stop request, and then stops the block operation for the mobile terminal **300** corresponding to the terminal ID included in the stop request.

In step S**403**, upon receiving from the monitoring unit **104** the terminal ID and the notification indicating that the data communication of the mobile terminal **300** of the monitoring target is resumed in step S**305**, the state control unit **103**B sends the block stop request including this terminal ID to the block unit **107**. The block unit **107** receives the block stop request, and then stops the block operation for the mobile terminal **300** corresponding to the terminal ID included in the stop request.

According to the specific example described in this embodiment, it is possible to obtain the effect of the specific example described in the first embodiment, and it is also possible to cause the radio base station **100** to perform the operation for blocking a request or an event that triggers transition of the mobile terminal **300** from the CONNECTED state to the IDLE state, based on an instruction from the core network **10** (specifically, the mobility management node **200**). For example, a request for transition from the CONNECTED state to the IDLE state, which

reaches the radio base station **100** from the mobile terminal **300**, can be blocked for a certain period of time.

Third Embodiment

This embodiment illustrates an example in which the core network **10** notifies the radio base station **100** of a policy related to control of a radio resource when the mobile terminal **300** in the CONNECTED state is not performing data communication (hereinafter referred to as "radio control policy"), as well as the state control policy described in the first embodiment.

FIG. **12** is a block diagram showing a configuration example of the mobility management node **200** in this embodiment. In the example of FIG. **12**, parameters included in the state control policy held in a policy management unit **204**C are partially different from the parameters of the state control policy held in the policy management unit **204** shown in FIG. **2**. The other elements shown in FIG. **12** are similar to the corresponding elements of FIG. **2**.

FIG. **13** is a block diagram showing a configuration example of the radio base station **100** in this embodiment. As compared with the configuration example shown in FIG. **4**, a radio control unit **108** is added in the example of FIG. **13**. The functions of the state control unit **103**C shown in FIG. **13** are partially different from the functions of the state control unit **103** shown in FIG. **4**. The other components shown in FIG. **13** are similar to the corresponding elements of FIG. **4**.

The policy management unit **204**C of the mobility management node **200** stores the above-mentioned "radio control policy", i.e., the policy related to control of a radio resource when the mobile terminal in the CONNECTED state is not performing data communication, as well as the policy for performing control for the CONNECTED-IDLE transition (for example, the IDLE transition interval of the mobile terminal **300**, and the block policy). FIG. **14** shows a specific example of the state control policies managed by the policy management unit **204**C. In the example of FIG. **14**, the radio control policy is added as one of the state control policies. An example of the radio control policy is an interval of discontinuous reception (DRX) of the mobile terminal **300** in the CONNECTED state.

The state control unit **130**C of the radio base station **100** has the functions of the state control unit **103** described above with reference to FIG. **4**. Further, the state control unit **103**C has the function of notifying the radio control unit **108** of the terminal ID included in the request and the radio control policy within the state control policy, upon receiving the state control request from the mobility management node **200**.

According to the terminal ID and the radio control policy which are notified from the state control unit **103**C, the radio control unit **108** of the radio base station **100** performs the radio resource control (specifically, setting of DRX) of the mobile terminal **300** corresponding to the notified terminal ID. The radio control unit **108** controls the radio resource based on the radio control policy for each mobile terminal **300**. The discontinuous reception (DRX) in the case where the mobile terminal **300** is in the CONNECTED state (i.e., RRC_CONNECTED state) can be controlled. For example, it is proposed that the base station **100** configures the discontinuous reception (DRX) while observing an activity of the mobile terminal **300** (Reference: 3GPP TS 36.300 "Evolved Universal Terrestrial Radio Access (E-UTRA) And Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall Description").

Next, the operation of the radio base station **100** of this embodiment will be described with reference to the flowchart of FIG. **15**. FIG. **15** shows a process to be carried out when the radio base station **100** receives the state control request from the mobility management node **200** via the core-side interface **101**. Here, steps different from those shown in FIG. **7** described above are focused and described, and the description of the same steps as those shown in FIG. **7** is omitted.

In step S**500**, the state control unit **103**C acquires the terminal ID and the radio control policy within the state control policy from the received state control request, and sets the terminal ID and the radio control policy to the radio control unit **108**.

In step S**501**, the state control unit **103**C notifies the radio control unit **108** of the radio control start request and the terminal ID included in the notification received from the monitoring unit **104** in step S**303**. The radio control unit **108** starts the radio control (setting of DRX value) for the mobile terminal **300** corresponding to the notified terminal ID based on the radio control policy (DRX value) configured in step S**500**.

Next, in step S**502**, upon receiving the notification which indicates that the configured time is expired and includes the terminal ID, from the timer function unit **105** in step S**306**, the state control unit **103**C sends a radio control stop request including the terminal ID to the radio control unit **108**. The radio control unit **108** receives the radio control stop request, and then stops the radio control for the mobile terminal **300** corresponding to the terminal ID included in the stop request.

Next, in step S**503**, upon acquiring, from the monitoring unit **104**, the terminal ID and the notification indicating that the data communication of the mobile terminal **300** of the monitoring target is resumed in step S**305** of the first embodiment, the state control unit **103**C sends the radio control stop request including this terminal ID to the radio control unit **108**. The radio control unit **108** having received the radio control stop request stops the radio control for the mobile terminal **300** corresponding to the terminal ID included in the stop request. If the DRX is deactivated at the timing of step S**503**, this process is ignored.

According to the specific example described in this embodiment, it is possible to obtain the effect of the specific example described in the first embodiment, and it is also possible to perform, for the radio base station **100**, the setting for handling the radio resource related to the mobile terminal **300** maintained in the CONNECTED state, based on an instruction from the core network **10** (specifically, the mobility management node **200**). For example, the interval of the DRX by the mobile terminal **300** in the case where there is no data communication in the CONNECTED state can be configured to the radio base station **100** from the core network **10** for each mobile terminal **300**.

Fourth Embodiment

In this embodiment, a specific example of the timing of determining a terminal to be subjected to a state control (i.e., control target terminal) will be described. Specifically, in this embodiment, the control target terminal is determined at the timing when the mobile terminal **300** connects (i.e., cell selection, cell reselection) or performs handover to the radio base station **100** under management of the mobility management node **200**.

FIG. **16** is a block diagram showing a configuration example of the mobility management node **200** in this embodiment. In the example of FIG. **16**, the functions of a control determination unit **202**D and a terminal management unit **203**D are partially different from the functions of the control determination unit **202** and the terminal management unit **203** which are described above with reference to FIG. **2**. The other elements shown in FIG. **16** are similar to the corresponding elements of FIG. **2**.

The terminal management unit **203**D of the mobility management node **200** has the functions of the terminal management unit **203** described above with reference to FIG. **2**. Further, when the mobile terminal **300** connects (i.e., cell selection, cell reselection) or performs handover to the radio base station **100**, the terminal management unit **203**D sends, to the control determination unit **202**D, a "connection notification" including the terminal ID of the mobile terminal **300** and the base station ID of radio base station **100** to which the mobile terminal **300** is connected.

The control determination unit **202**D of the mobility management node **200** has the functions of the control determination unit **202** described above with reference to FIG. **2**. Further, upon receiving a connection notification indicating the connection of the mobile terminal **300** from the terminal management unit **203**D, the control determination unit **202**D confirms whether the new terminal **300** is a control target terminal. Then, when the new terminal **300** is judged as the control target terminal, the control determination unit **202**D requests the radio base station **100** to perform the state control of the terminal.

Referring next to the sequence diagram of FIG. **17**, a description will be made of a flow of processes for starting the state control for the mobile terminal upon being triggered by the connection or handover to the radio base station **100** of the mobile terminal **300**. In step S**600**, the mobile terminal **300** starts a connection process or a handover process for the radio base station **100**. At the time of starting this process, the mobile terminal **300** notifies the radio base station **100** of the terminal ID. Next, in step S**601**, the radio base station **100** transfers a connection request or a handover request received in step S**600** to the mobility management node **200**. In step S**602**, based on the terminal ID contained in the connection request or the handover request received in step S**601**, the mobility management node **200** checks whether the mobile terminal corresponding to the terminal ID is a control target terminal. That is, the connection request or the handover request sent from the radio base station **100** to the mobility management node **200** corresponds to the "connection notification". In step S**603**, when the checked mobile terminal is judged as the control target as a result of checking in step S**602**, the mobility management node **200** determines to start the state control for the mobile terminal. The subsequent procedure may be similar to step S**101** and subsequent steps shown in FIG. **5**.

Referring next to the flowchart of FIG. **18**, the operation of the mobility management node **200** of this embodiment will be described. FIG. **18** shows a process to be carried out when the mobility management node **200** receives the connection notification of the mobile terminal from the radio base station **100**. Here, steps different from those shown in FIG. **6** described above are focused and described, and the description of the same steps as those shown in FIG. **6** is omitted.

In step S**700**, the terminal management unit **203**D receives from the radio base station **100** the connection notification including the terminal ID of the terminal **300** which is attempting to connect or to perform handover to the radio base station **100**, and notifies the control determination unit **202**D of the terminal ID. Specific examples of the connection notification include a connection request and a handover request of the mobile terminal **100**.

In step S**701**, the control determination unit **202**D confirms whether the state control policy corresponding to the terminal ID acquired in step S**700** exists in the policy management unit **204**. When the state control policy does not exist, it is judged that the mobile terminal **300** corresponding to the terminal ID is not the control target, and the control process is completed. On the other hand, when the state control policy exists (YES in step S**701**), the process proceeds to step S**201** which is described above with reference to FIG. **6**.

According to the specific example described in this embodiment, it is possible to check whether the mobile terminal **300** is a terminal to be subjected to the state control including the control for the CONNECTED-IDLE transition, at the timing when the mobile terminal **300** connects or performs handover to the radio base station **100** under management of the mobility management node **200**, thereby making it possible to start the state control if the terminal is the control target terminal.

Fifth Embodiment

In this embodiment, a modification of a specific example of the arrangement of the state control policy described in the first embodiment will be described. Specifically, while FIG. **2** illustrates the configuration in which the mobility management node **200** includes the policy management unit **204**, this embodiment illustrates an example in which the policy management unit is arranged outside the mobility management node **200**.

FIG. **19** is a block diagram showing a configuration example of the mobile communications system according to this embodiment. As compared with the example of FIG. **1**, a subscriber server **400** is newly added in the example of FIG. **19**. The subscriber server **400** manages subscriber information and corresponds to an HSS (Home Subscriber Server) in the 3GPP. The subscriber server **400** of this embodiment is characterized by managing the state control policy for each user. FIG. **21** shows an example of the state control policy managed by the subscriber server **400**. In the example of FIG. **21**, the state control policy is managed as a piece of information that is managed for each subscriber, by using a subscriber ID for identifying each subscriber as a key.

FIG. **20** is a block diagram showing a configuration example of the mobility management node of this embodiment. In the example of FIG. **20**, the policy management unit **204** is omitted from the configuration example shown in FIG. **2** and a subscriber server interface **206** is added. The functions of a control determination unit **202**E are partially different from the functions of the control determination unit **202** shown in FIG. **2**. The other elements shown in FIG. **20** are similar to the corresponding elements of FIG. **2**.

The subscriber server interface **206** of the mobility management node **200** is an interface that enables exchange of the subscriber information, which includes the state control policy, between the mobility management node **200** and the subscriber server **400**. The control determination unit **202**E of the mobility management node **200** has the functions of the control determination unit **202** described above with reference to FIG. **2**. Further, when determining the state control for the mobile terminal **300**, the control determination unit **202**E sends an inquiry to the subscriber server **400**

by using the subscriber ID of the control target terminal, thereby acquiring the state control policy corresponding to the control target terminal.

Referring next to the sequence diagram of FIG. **22**, a description will be made of a flow of processes, in the mobile communications system shown in FIG. **19**, for acquiring the state control policy corresponding to the control target terminal from the subscriber server **400** when the mobility management node **200** determines the control target terminal to be subjected to the state control. First, in step S**800**, the mobility management node **200** determines the state control for a certain mobile terminal, and recognizes the subscriber ID of the control target terminal. In step S**801**, the mobility management node **200** sends, to the subscriber server **400**, a control policy request including the subscriber ID of the control target terminal. In step S**802**, the subscriber server **400** acquires, from the subscriber information managed by the subscriber server **400**, the state control policy corresponding to the subscriber ID contained in the control policy request acquired in step S**801**. Then, the subscriber server **400** returns, to the mobility management node **200**, a control policy response including the subscriber ID corresponding to the acquired state control policy. In step S**803**, the mobility management node **200** sends, to the radio base station **100**, the state control request including the state control policy acquired in step S**802**, thereby requesting the radio base station **100** to perform the state control including the control for the CONNECTED-IDLE transition for the control target terminal. The procedure of step S**802** and subsequent steps may be similar to step S**101** and subsequent steps shown in FIG. **5**.

Referring next to the flowchart of FIG. **23**, the operation of the mobility management node **200** of this embodiment will be described. FIG. **23** shows a process to be carried out when the mobility management node **200** starts the state control for the mobile terminal **300**. Here, step **900** which is a difference from FIG. **6** described above is focused and described, and the description of steps S**200**, S**202**, and S**203**, which are the same as those of FIG. **6**, is omitted. In step S**900**, the control determination unit **202**E sends a request for the state control policy to the subscriber server **400** by using the terminal ID (subscriber ID in this case) of the control target terminal, and acquires the state control policy corresponding to the terminal ID (subscriber ID) from the subscriber server **400**.

According to the specific example described in this embodiment, the state control policy related to the control for the CONNECTED-IDLE transition of the mobile terminal are registered as a part of the subscriber information in the subscriber server **400** for each subscriber, thereby enabling the state control for each subscriber.

Sixth Embodiment

In this embodiment, a specific example of a method for determining a terminal to be subjected to a state control (i.e., control target terminal) will be described. FIG. **24** is a block diagram showing a configuration example of the mobility management node **200** in this embodiment. As compared with the example of FIG. **2**, a communication monitoring unit **207** and a check item management unit **208** are added in the example of FIG. **24**. In the example of FIG. **24**, the functions of a control determination unit **202**F and a policy management unit **204**F are partially different from the functions of the control determination unit **202** and the policy management unit **204** which are shown in FIG. **2**. The other elements shown in FIG. **24** are similar to the corresponding elements of FIG. **2**. Note that, the communication monitoring unit **207** and the check item management unit **208** are implemented as a function of the mobility management node **200** in the example of FIG. **24**, but may be arranged in another node which is different from the mobility management node **200**.

The check item management unit **208** manages check items to be monitored by the communication monitoring unit **206** and check IDs respectively corresponding to the check items. FIG. **25** shows an example of the check items managed by the check item management unit **208**. In the example of FIG. **25**, a frequency of occurrence of the state transition between the CONNECTED state and the IDLE state of the mobile terminal **300** is one of the check items. Specifically, checking whether the state transition of the mobile terminal **300** between the CONNECTED state and the IDLE state is performed **10** times or more within 10 minutes is a check item (check ID: 0001). Further, in the example of FIG. **25**, the degree of stagnation of the mobile terminal **300** is one of the check items. Specifically, checking whether the mobile terminal **300** does not move from the same base station for 30 minutes or more is a check item (check ID: 0002).

The communication monitoring unit **207** monitors the communication based on the check items, which are managed by the check item management unit **208**, for all the mobile terminals **300** connected to the radio base station **100** under management of the mobility management node **200**. When the mobile terminal **300** that performs an operation corresponding to the check item is found, the communication monitoring unit **207** notifies the control determination unit **202**F of the terminal ID of the found mobile terminal and the check ID corresponding to the detected check item.

The policy management unit **204**F stores the state control policies respectively corresponding to the check IDs managed by the check item management unit **208**. FIG. **26** shows an example of the state control policies managed by the policy management unit **204**F. In the example of FIG. **26**, the state control policy is managed using the check ID common to the check item management unit **208** as a primary key.

The control determination unit **202**F has the functions of the control determination unit **202** described above with reference to FIG. **2**. Further, upon acquiring the terminal ID and the check ID from the communication monitoring unit **207**, the control determination unit **202**F acquires the state control policy corresponding to the check ID from the policy management unit **204**F by using the check ID, and starts the state control by using the acquired state control policy and the terminal ID.

Referring next to the flowchart of FIG. **27**, the operation of the mobility management node **200** of this embodiment will be described. FIG. **27** shows a process during a period from the time when the communication monitoring unit **207** starts to monitor the communication of the mobile terminal **300** to the time when the communication monitoring unit **207** starts the state control for a specific mobile terminal. Here, steps different from those shown in the flowchart of FIG. **6** are focused and described, and the description of the same steps as those shown in FIG. **6** is omitted.

In step S**1000**, the communication monitoring unit **207** starts to monitor the communication operation of the mobile terminal **300** connected to the radio base station **100**, based on the check items recorded in the check item management unit **208**. In step S**1001**, when the mobile terminal **300** that performs an operation corresponding to a check item is found, the communication monitoring unit **207** notifies the control determination unit **202**F of the terminal ID of the

found mobile terminal and the check ID corresponding to the detected check item. In step S**1002**, upon receiving the terminal ID and the check ID from the communication monitoring unit **207**, the control determination unit **202**F acquires the state control policy corresponding to the check ID from the policy management unit **204**F by using the check ID, and starts the state control by using the state control policy corresponding to the received terminal ID.

According to the specific example described in this embodiment, the state control policies for the respective communication characteristics of each mobile terminal **300** are prepared, and the communication characteristics for each mobile terminal **300** are monitored, thereby making it possible to control the CONNECTED-IDLE transition according to the communication characteristics for each mobile terminal.

Seventh Embodiment

In this embodiment, a modification of a specific example (that is, IDLE transition interval) of parameters designated by the state control policies described in the first embodiment will be described. Specifically, in this embodiment, instead of the IDLE transition interval of the mobile terminal **300**, a policy for blocking a request or an event that triggers transition of the mobile terminal **300** from the CONNECTED state to the IDLE state is used as a parameter of the state control policy.

FIG. **28** is a block diagram showing a configuration example of the mobility management node **200** in this embodiment. In the example of FIG. **28**, the functions of a control determination unit **202**H are partially different from the functions of the policy management unit **204** shown in FIG. **2**. The types of policies recorded in a policy management unit **204**H are partially different from those of the policy management unit **204** shown in FIG. **2**. In the example of FIG. **28**, a block start notification unit **209** is added instead of the policy notification unit **205**, and a block stop notification unit **210** is also added. The other elements shown in FIG. **28** are similar to the corresponding elements of FIG. **2**.

FIG. **29** is a block diagram showing a configuration example of the radio base station **100** in this embodiment. As compared with the example of FIG. **4**, the monitoring unit **104**, the timer function unit **105**, and the IDLE transition start unit **106** are omitted and a block unit **107**H is added in the example of FIG. **29**. The functions of a state control unit **103**H are partially different from the functions of the state control unit **103** described above with reference to FIG. **4**. The other elements shown in FIG. **29** are similar to the corresponding elements of FIG. **4**.

The policy management unit **204**H of the mobility management node **200** manages the block policy for each mobile terminal **300**. As described in the second embodiment of the invention, the block policy is a policy for blocking a request or an event that triggers transition of the mobile terminal **300** from the CONNECTED state to the IDLE state. FIG. **30** shows a specific example of the state control policies of this embodiment which are managed by the policy management unit **204**B. In the example of FIG. **30**, the terminal ID of the control target terminal is configured as a primary key, and the block policy corresponding to the primary key is managed.

The control determination unit **202**H determines the mobile terminal **300** on which the block control is imposed from among the mobile terminals **300** connected to the radio base station **100** under management of the mobility management node **200**, acquires the control policy corresponding to the control target terminal from the policy management unit **204**H, and notifies the block start notification unit **209** of the terminal ID of the block start target terminal and the control policy to be applied. Further, the control determination unit **202**H determines the mobile terminal **300** on which the block control is stopped, and notifies the block stop notification unit **210** of the terminal ID of the mobile terminal **300** on which the block control is stopped.

Upon acquiring, from the control determination unit **202**H, the terminal ID of the block start target terminal and the state control policy to be applied, the block start notification unit **209** sends the block start request including the terminal ID and the state control policy to the radio base station **100**.

Upon acquiring the terminal ID of the block stop target terminal from the control determination unit **202**H, the block stop notification unit **210** sends the block stop request including the terminal ID to the radio base station **100**.

Upon receiving the block start request from the mobility management node **200**, the state control unit **103**H of the radio base station **100** notifies the block unit **107**H of the terminal ID and the block policy within the state control policy contained in the start request, as the block start request. Further, upon receiving the block stop request from the mobility management node **200**, the state control unit **103**H notifies the block unit **107**H of the terminal ID contained in the received stop request, as the block stop request.

The block unit **107**H of the radio base station **100** has the functions similar to those of the block unit **107** described above with reference to FIG. **9**. Specifically, when the block start request is received from the state control unit **103**H, the block unit **107**H starts blocking based on the terminal ID and the block policy contained in the start request. Further, upon acquiring the block stop request from the state control unit **103**H, the block unit **107**H stops blocking with respect to the terminal ID contained in the stop request.

According to the specific example described in this embodiment, it is possible to cause the radio base station **100** to perform the operation for blocking a request or an event that triggers transition of the mobile terminal **300** from the CONNECTED state to the IDLE state, based on an instruction from the core network **10** (specifically, the mobility management node **200**). In other words, according to the specific example described in this embodiment, it is possible for the core network **10** to proactively control the timing of the CONNECTED-IDLE transition in the mobile terminal **300** based on the determination by the core network **10** (i.e., the mobility management node **200**). Accordingly, the number of signalings which are caused due to repetition of the CONNECTED-IDLE transition of the mobile terminal **300** and which are to be processed by the core network **10** can be reduced based on the determination by the core network **10**.

Other Embodiment

Any combination of the specific examples described in the first to seventh embodiments of the invention may be implemented.

The function of the mobility management node **200** serving as "policy supply system" described in the first to seventh embodiments, i.e., "the function for supplying the radio access network **20** with the state control policy related to the CONNECTED-IDLE transition of the mobile terminal **300**" may be arranged in another node that is arranged in the

core network **10** and is different from the mobility management node. Further, the function of the mobility management node **200** serving as "policy supply system" described in the first to seventh embodiments may be arranged in a manner distributed to a plurality of nodes in the core network **10**. In other words, the arrangement of the function of the mobility management node **200** serving as "policy supply system" described in the first to seventh embodiments is appropriately determined based on the design concept of the network architecture. As a specific example, in the case of applying the first to seventh embodiments to the UMTS in the 3GPP, the function of the above-mentioned mobility management node **200** serving as "policy supply system" may be arranged in the GGSN (Gateway GPRS Support Node). Furthermore, the function of the mobility management node **200** described in the first to seventh embodiments may be arranged in the O&M (Operations & Maintenance) server.

The function of the radio base station **100** serving as "a control apparatus that performs the state control related to the CONNECTED-IDLE transition of the mobile terminal **300**" described in the first to seventh embodiments may be arranged in another node that is different from the radio base station **100**. Specifically, the function may be arranged in a node that is arranged in the radio access network **20** and has a radio resource management function. As a specific example, in the case of applying the first to seventh embodiments to the UMTS in the 3GPP, the function of the above-mentioned radio base station **100** may be implemented not by the NB (NodeB), but by a modification of scheduling function and radio bearer management function of the RNC (Radio Network Controller). In the case of applying this embodiment to a communication system of the WiMAX Forum, the operation of the radio base station **100** described above may be implemented not by the BS (Base Station), but by a modification of the functions of the ASN-GW (Access Service Network Gateway).

The first to seventh embodiments illustrate an example in which the state control policy is supplied from the core network **10** (typically, the mobility management node **200**) to the radio base station **100**, and the radio base station **100** performs control for the CONNECTED-IDLE transition of the mobile **300** based on the state control policy. However, the state control policy determined by the core network **10** may be supplied to the mobile terminal **300** from the core network **10**. In this case, the mobile terminal **300** may autonomously control the CONNECTED-IDLE transition of itself according to the state control policy received from the core network **10**. That is, the function of the radio base station **100** serving as "a control apparatus that performs a state control related to the CONNECTED-IDLE transition of the mobile terminal **300**" described in the first to seventh embodiments may be arranged in the mobile terminal **300** itself. Also such modifications make it possible to reduce the number of signalings, which are caused due to repetition of the state transition (CONNECTED-IDLE transition) of the mobile terminal and are to be processed by the core network, based on the determination by the core network.

The process for requesting the state control to the radio base station **100** by the mobility management node **200** and the process for controlling the CONNECTED-IDLE transition of the mobile terminal **300** based on the state control policy from the mobility management node **200** by the radio base station **100**, which are described in the first to seventh embodiments, may be implemented using a semiconductor processing device such as an ASIC (Application Specific Integrated Circuit) or a DSP (Digital Signal Processor). These processes may also be implemented by causing a computer, such as a microprocessor, to execute a program. Specifically, a program including instructions for causing a computer to execute an algorithm shown in at least one of FIGS. **6**, **7**, **11**, **15**, **18**, **23**, and **27** may be prepared and supplied to a computer.

This program can be stored and provided to a computer using any type of non-transitory computer readable media. Non-transitory computer readable media include any type of tangible storage media. Examples of non-transitory computer readable media include magnetic storage media (such as floppy disks, magnetic tapes, hard disk drives, etc.), optical magnetic storage media (e.g., magneto-optical disks), CD-ROM (Read Only Memory), CD-R, CD-R/W, and semiconductor memories (such as mask ROM, PROM (Programmable ROM), EPROM (Erasable PROM), flash ROM, RAM (random access memory), etc.). The program may be provided to a computer using any type of transitory computer readable media. Examples of transitory computer readable media include electric signals, optical signals, and electromagnetic waves. Transitory computer readable media can provide the program to a computer via a wired communication line, such as electric wires and optical fibers, or a radio communication line.

In addition, the present invention is not limited to the above-described embodiments, and various modifications can be made without departing from the scope of the present invention described above.

This application is based upon and claims the benefit of priority from Japanese patent application No. 2011-000992, filed on Jan. 6, 2011, the disclosure of which is incorporated herein in its entirety by reference.

REFERENCE SIGNS LIST

10 CORE NETWORK
20 RADIO ACCESS NETWORK (RADIO ACCESS NETWORK: RAN)
100 RADIO BASE STATION
101 CORE-SIDE INTERFACE
102 RADIO INTERFACE
103 STATE CONTROL UNIT
104 MONITORING UNIT
105 TIMER FUNCTION
106 IDLE TRANSITION START UNIT
103B STATE CONTROL UNIT IN SECOND EMBODIMENT
107 BLOCK UNIT IN SECOND EMBODIMENT
113C STATE CONTROL UNIT IN THIRD EMBODIMENT
108 RADIO CONTROL UNIT IN THIRD EMBODIMENT
103H STATE CONTROL UNIT IN SEVENTH EMBODIMENT
107H BLOCK UNIT IN SEVENTH EMBODIMENT
200 MOBILITY MANAGEMENT NODE
201 INTERFACE
202 CONTROL DETERMINATION UNIT
203 TERMINAL MANAGEMENT UNIT
204 POLICY MANAGEMENT UNIT
205 POLICY NOTIFICATION UNIT
204B POLICY MANAGEMENT UNIT IN SECOND EMBODIMENT
204C POLICY MANAGEMENT UNIT IN THIRD EMBODIMENT
202D CONTROL DETERMINATION UNIT IN FOURTH EMBODIMENT

203D TERMINAL MANAGEMENT UNIT IN FOURTH EMBODIMENT
204C CONTROL DETERMINATION UNIT IN FIFTH EMBODIMENT
206 SUBSCRIBER SERVER INTERFACE IN FIFTH EMBODIMENT
202F CONTROL DETERMINATION UNIT IN SIXTH EMBODIMENT
204F POLICY MANAGEMENT UNIT IN SIXTH EMBODIMENT
207 COMMUNICATION MONITORING UNIT IN SIXTH EMBODIMENT
208 CHECK ITEM MANAGEMENT UNIT IN SIXTH EMBODIMENT
209 BLOCK START NOTIFICATION UNIT IN SEVENTH EMBODIMENT
210 BLOCK STOP NOTIFICATION UNIT IN SEVENTH EMBODIMENT
300 MOBILE TERMINAL
400 SUBSCRIBER SERVER

The invention claimed is:

1. A mobile communications system comprising:
a supply unit arranged in a core network configured to:
monitor communication of at least one mobile terminal;
determine, from among the at least one mobile terminal, a control target terminal that is subjected to control of a state transition between a CONNECTED state and an IDLE state, based on the communication of the at least one mobile terminal;
determine a parameter which indicates an idle transition interval of the control target terminal; and
supply a radio base station that is arranged in a radio access network with the parameter; and
the radio base station configured to perform the control of the state transition of the control target terminal based on the parameter.

2. The mobile communications system according to claim **1**, wherein the parameter is related to reducing the state transition of the control target terminal and is determined based on information about behavior of the control target terminal.

3. A method realized by a radio base station that is arranged in a radio access network in a mobile communication system, the method comprising:
receiving, from a supply unit arranged in a core network, a parameter which indicates an idle transition interval of a control target terminal that is subjected to control of a state transition between a CONNECTED state and an IDLE state, wherein the control target terminal is determined, from among at least one mobile terminal whose communication is monitored by the supply unit, based on the communication of the at least one mobile terminal; and
performing the control of the state transition of the mobile terminal based on the parameter.

4. The method according to claim **3**, wherein the parameter is related to reducing the state transition of the control target terminal and is determined based on information about behavior of the control target terminal.

5. A radio base station that is arranged in a radio access network, the radio base station configured to:
receive, from a supply unit arranged in a core network, a parameter which indicates an idle transition interval of a control target terminal that is subjected to control of a state transition between a CONNECTED state and an IDLE state; and
perform the control of the state transition of the control target terminal based on the parameter, wherein
the control target terminal is determined, from among at least one mobile terminal whose communication is monitored by the supply unit, based on the communication of the at least one mobile terminal.

6. The radio base station according to claim **5**, wherein the parameter is related to reducing the state transition of the control target terminal and is determined based on information about behavior of the control target terminal.

7. A supply unit arranged in a core network, the supply unit configured to:
monitor communication of at least one mobile terminal;
determine, from among the at least one mobile terminal, a control target terminal that is subjected to control of a state transition between a CONNECTED state and an IDLE state, based on the communication of the at least one mobile terminal;
determine a parameter which indicates an idle transition interval of the control target terminal; and
supply a radio base station with the parameter,
wherein the radio base station is arranged in a radio access network and is configured to:
perform the control of the state transition of the control target terminal based on the parameter.

8. The supply unit according to claim **7**, wherein the parameter is related to reducing the state transition of the control target terminal and is determined based on information about behavior of the mobile terminal.

9. The supply unit according to claim **7**, configured to monitor the at least one mobile terminal based on a check item managed by the supply unit.

10. The supply unit according to claim **9**, wherein the check item includes a frequency of occurrence of state transitions of the at least one mobile terminal.

11. The supply unit according to claim **9**, wherein the check item includes a degree of stagnation of the at least one mobile terminal.

12. The mobile communications system according to claim **1**, wherein the supply unit is configured to monitor the at least one mobile terminal based on a check item managed by the supply unit.

13. The mobile communications system according to claim **12**, wherein the check item includes a frequency of occurrence of state transitions of the at least one mobile terminal.

14. The mobile communications system according to claim **12**, wherein the check item includes a degree of stagnation of the at least one mobile terminal.

15. The method according to claim **3**, wherein the supply unit is configured to monitor the at least one mobile terminal based on a check item managed by the supply unit.

16. The method according to claim **15**, wherein the check item includes a frequency of occurrence of state transitions of the at least one mobile terminal.

17. The method according to claim **15**, wherein the check item includes a degree of stagnation of the at least one mobile terminal.

18. The radio base station according to claim **5**, wherein the supply unit is configured to monitor the at least one mobile terminal based on a check item managed by the supply unit.

19. The radio base station according to claim **18**, wherein the check item includes a frequency of occurrence of state transitions of the at least one mobile terminal.

20. The radio base station according to claim **18**, wherein the check item includes a degree of stagnation of the at least one mobile terminal.

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